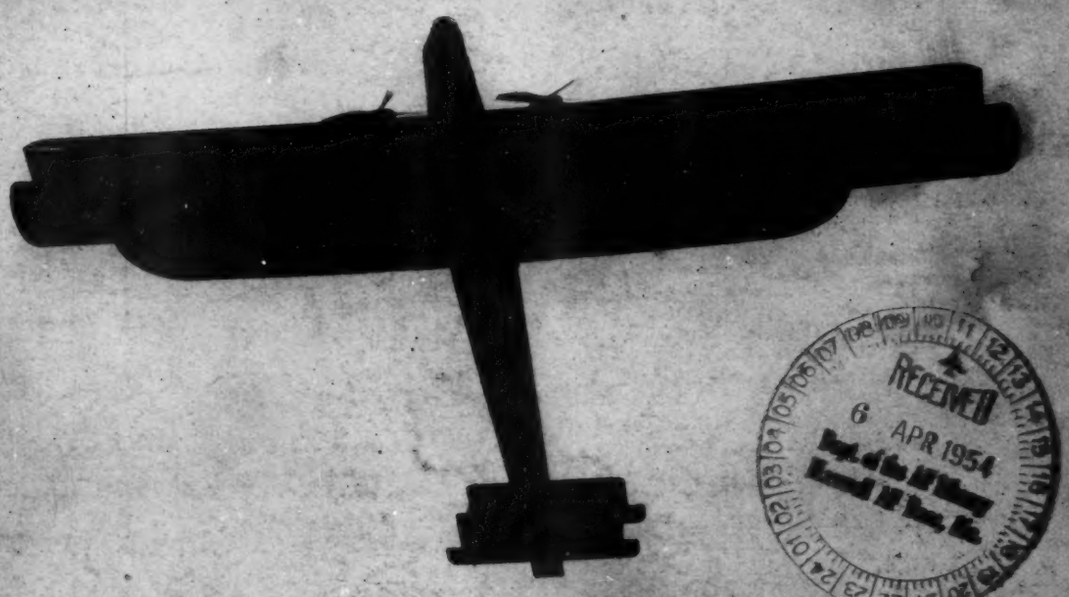
JULY 15, 1918 PRICE 15 CENTS

NOTICE TO READER—When you finish reading this magazine place a one-cent stamp on this notice, mail the magazine and it will be placed in the hands of our soldiers or sailors stationed in foreign service. No wrapping—no address.

AVIATION AND AERONAUTICAL ENGINEERING



RECEIVED 6 APR 1954

Handley-Page Bomber Climbing "All Out"
(C) Press Illustrating Service

VOLUME IV
Number 12

Two Dollars a Year

SPECIAL FEATURES

THE FIRST AMERICAN HANDLEY PAGE BOMBER

THE A. E. G. TWIN ENGINED BOMBER, G105

THE FOKKER WING TRUSS

THE PFALZ PURSUIT BIPLANE

PUBLISHED SEMI-MONTHLY
BY
THE GARDNER-MOFFAT CO., Inc.
120 W. 32nd ST NEW YORK

Entered as second-class matter, August 9, 1916, at the Post Office at New York, N. Y., under act of March 3, 1879.

AIRCRAFT

MARTIN
U.S.A.

TRADE MARK

THE entire organization and skill, experience and ability of this company are devoted to intensive production in the interests of the United States for the period of the war.

WHEN peace comes Martin commercial and pleasure airplanes will maintain the supremacy of performance and dependability which they have held since 1909.

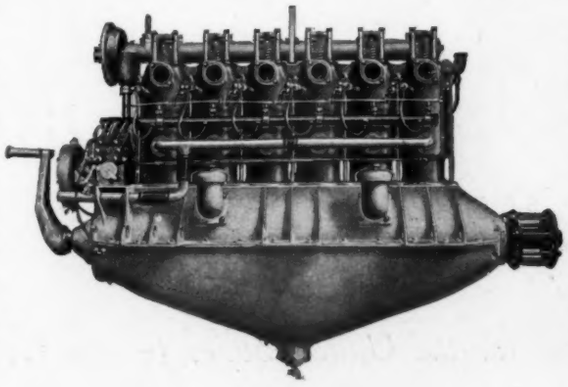
THE GLENN L. MARTIN COMPANY

CLEVELAND, OHIO

Contractors to the United States Government

New American Endurance Run Established

On April 12th, the Loughead Seaplane F-1 established a new American duration record. This seaplane, the largest ever constructed on the Pacific Coast, made the trip, with a pilot and three passengers, from Santa Barbara to San Diego, a distance of 211 miles, in 181 minutes.



The F-1 is designed for aerial patrol and is motored by two Six Cylinder *Hall-Scott* A-5 150 *h.p.* Airplane Engines.

Catalog on Request

HALL-SCOTT MOTOR CAR COMPANY

General Offices: CROCKER BUILDING SAN FRANCISCO, CALIFORNIA

HALL-SCOTT

CONTRACTORS TO

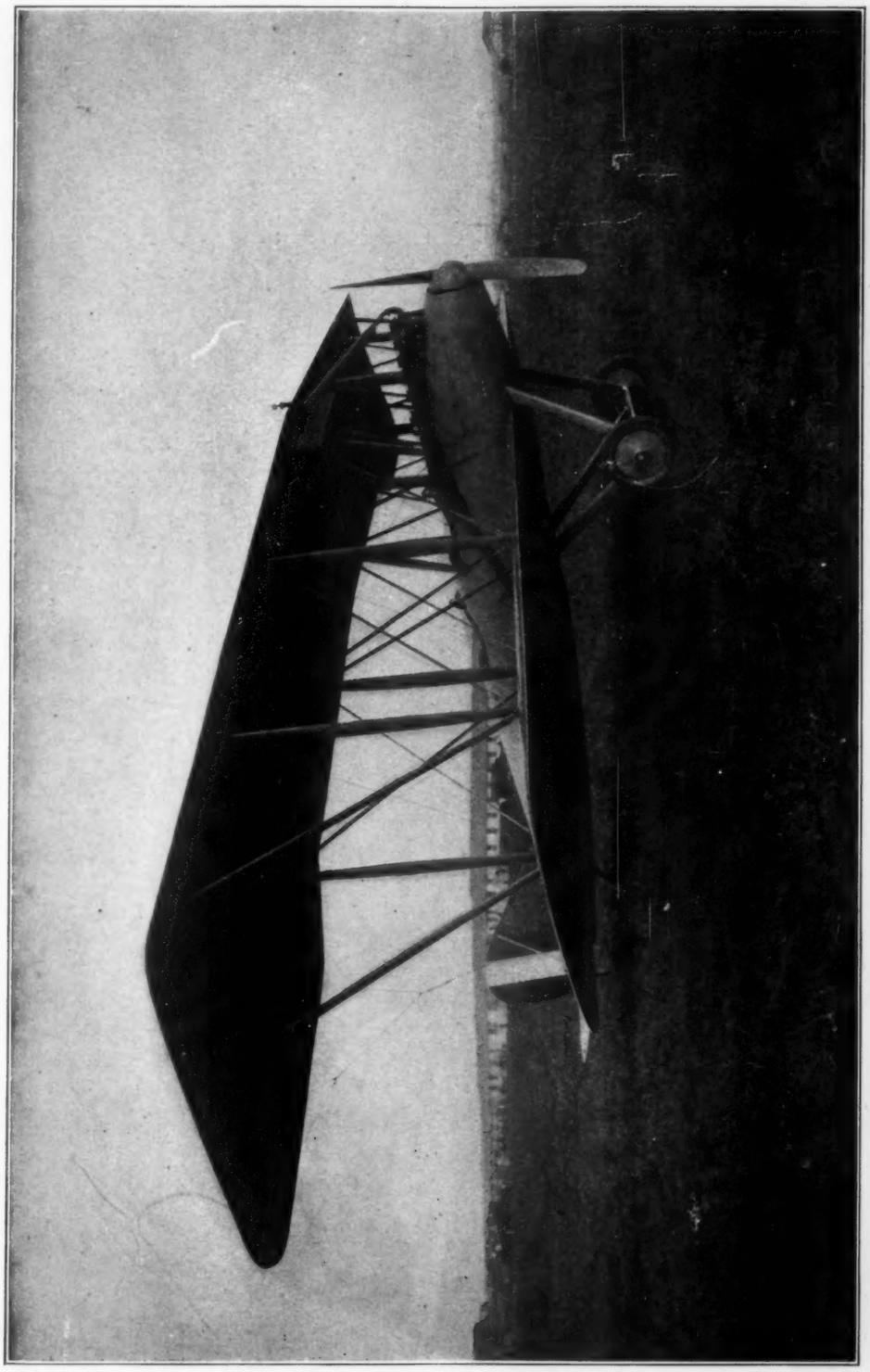
The United States Army and Navy

The British Admiralty

THE BURGESS COMPANY

MARBLEHEAD, MASS.

Sole Licensees for the United States for the Dunne Patents



·L·W·F·ENGINEERING·COMPANY·
COLLEGE POINT, N. Y.

NEW ENDURANCE RECORD

Established by

Union Airplane Motor at U. S. Aeronautical Testing Laboratory, Navy Yard, Washington, D. C.

Best previous record exceeded by fifty per cent.

UNION GAS ENGINE COMPANY

ESTABLISHED 1885

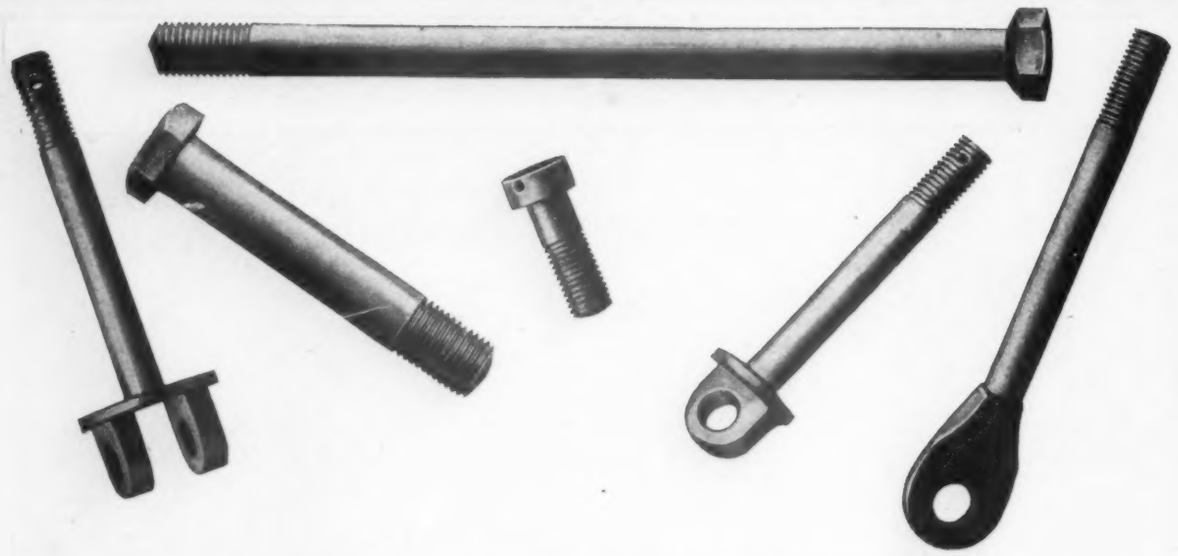
OAKLAND - - - CALIFORNIA

To build a weapon of the skies, invincible as Jove's great Thunderbolt of old—that is the work to which our all is dedicated.

STANDARD AIRCRAFT CORPORATION
ELIZABETH NEW JERSEY

A REAL FIGHTING INDUSTRY

Member of Manufacturers' Aircraft Association, Inc.



The parts shown on this page are used in AEROPLANE CONSTRUCTION. All being manufactured on AUTOMATIC MACHINES from our COLD DRAWN 3½% NCKEL STEEL. When you desire

3½% NICKEL STEEL

which will be uniform in quality, write or wire

SALES OFFICES
1001 Ford Bldg., Detroit, Mich.
801 Conover Bldg., Dayton, Ohio
617 Merchants Bank Building, Indianapolis, Indiana

The Betz-Pierce Co.
"STEEL OF QUALITY"
2230-40 East Ninth Street, Cleveland

SALES OFFICES
1308-9 Park Bldg. Pittsburgh, Pennsylvania
591 Ellicott Square Bldg Buffalo, New York

A WELL ASSORTED STOCK OF BARS CARRIED IN CLEVELAND

Radiation
not just
Radiators
We are in possession of radiator data of real scientific value, which eliminates any necessity for guesswork in designing cooling systems. To users of Mayo radiators this fact lends absolute confidence in their radiator equipment.
Can our engineers be of service to you?

MAYO Radiators

MAYO RADIATOR DIVISION of MARLIN ROCKWELL Corporation · 143rd Street and Southern Boulevard, NEW YORK CITY

PUBLISHER'S ANNOUNCEMENT

SALE OF AVIATION AN
AT NEWSSTAND

THE WAR INDUSTRIES BOARD has directed that beginning July 15, newspapers "discontinue the acceptance of the return of unsold copies."

It is expected that this order will be followed by another order directing the publishers of semi-monthly publications, such as AVIATION AND AERONAUTICAL ENGINEERING, to discontinue accepting from news dealers any copies that have been placed in their hands for sale.

EXPLANATION

The custom in the periodical publishing business for years past has been to place in the hands of the American News Co., such copies of each edition as are required by the news dealers of the country for their stands. The American News Co. through its excellent organization distributes these copies to the dealers, taking care to place no more copies with any news dealer than he is considered capable of selling.

In this way, the American News Co. looks after the interests of both the publisher and the news dealer, and acts as a valuable circulation builder, as it is to the company's advantage to sell to the dealers the largest possible number of copies that they can sell—and no more.

Any copies that are unsold by the dealers are sold back to the American News Co. which in turn returns them to the publisher.

A CONSERVATION MEASURE

This system has worked out for the benefit of the publishers and for the readers of prominent publications, but it now looks as if it must be radically modified, as the need for conservation of print paper is such that it is believed that at an early date The War Industries Board will direct that the privilege of returning unsold copies be entirely done away with.

A WAR CONSERVATION MEASURE

AERONAUTICAL ENGINEERING TO BE CURTAILED

The American News Co. will then buy no copies of any periodical that it cannot sell to its dealers and the dealers will probably purchase no copies that they are not positive can be sold. This will undoubtedly cause a great curtailment in the number of periodicals carried on newsstands.

Dealers in order to protect themselves will keep in stock only sufficient copies of periodicals to take care of ***orders*** placed in their hands. It will therefore be difficult to secure any publication regularly from a news dealer unless an advance order is placed with him for regular service.

SECURE AVIATION REGULARLY

In order that you may receive each number of AVIATION regularly, one of these three methods may be followed:

1—Direct your news dealer to deliver AVIATION each week. Give him a standing order to that effect.

2—Ask your news dealer to have AVIATION sent to you by mail for one year and pay him the regular subscription price of Two Dollars. He will place your order with the Subscription Department of the American News Co., and will receive a commission that will pay him for his trouble.

3—Fill out the order blank in the lower right hand corner of this page, attach a dollar bill and mail direct to the publishers. You will then receive AVIATION for six months by mail.

IF YOU WANT EVERY COPY OF AVIATION SUBSCRIBE NOW

AVIATION
120 W. 32nd St.
New York

Please enter my subscription to AVIATION for six months, for which I enclose one dollar.

NAME.....

ADDRESS.....

.....

ON THE PRESS

Aeronautical Engineering *and* Airplane Design

By SERGEANT ALEXANDER KLEMIN

Aviation Section, Signal Corps, U. S. A., in charge of Aeronautical Research Department, Airplane Engineering Department. Until entering military service, in charge of Department of Aeronautics, Massachusetts Institute of Technology and Technical Editor of *Aviation and Aeronautical Engineering.*

Based on a series of articles in *Aviation and Aeronautical Engineering* by Alexander Klemin and T. H. Huff, S.B., Aeronautical Engineer for the Standard Aero Corporation, formerly instructor in Aeronautics, Massachusetts Institute of Technology.

AN AUTHORITATIVE
HAND-BOOK : REFERENCE BOOK : TEXT-BOOK
for AERONAUTICAL ENGINEERS, DESIGNERS AND STUDENTS

Thirteen chapters on aerodynamical theory and data; twelve chapters on airplane design; profusely illustrated with photographs, charts and diagrams; printed on heavy paper; bound in cloth, lettered in gold

PRICE, POSTPAID, IN THE UNITED STATES $5.00 *net*

This book, which is based upon the course in Aeronautical Engineering at the Massachusetts Institute of Technology and prepared by the instructors at that institution, is the only complete work on the subject. It was recently printed serially in *Aviation and Aeronautical Engineering* as a " Course in Aerodynamics and Airplane Design," and was immediately recognized as the indispensable authority for the aeronautical engineer.

Owing to the great demand for this work, the text and illustrations have been thoroughly revised and brought up-to-date, and the course is being reprinted in book form.

THE GARDNER-MOFFAT COMPANY, INC., ADVANCE ORDER FORM
120 WEST THIRTY-SECOND STREET, NEW YORK CITY.

Send me, by parcel post C. O. D., a copy of " Aeronautical Engineering and Airplane Design " as soon as issued.

Name .....

Address .....

ERIE STANDARD
AIRCRAFT METAL PARTS

A DEPENDABLE SOURCE

Our plant at Erie—the largest of its kind—manufactures solely AIRCRAFT BOLTS, NUTS and CLEVIS PINS.

A large representative stock, conforming to Government specifications, is available for immediate use and delivery.

Our catalogue of AIRCRAFT BOLTS, NUTS and CLEVIS PINS is ready for distribution. Request our New York Office to send you a copy.

ERIE SPECIALTY COMPANY
8 West 40th Street, New York City
Main Plant, Erie, Pa.

WYMAN-GORDON

Only long experience can produce forgings which will meet the exacting demands of the successful airplane.

The unvarying reliability of Wyman-Gordon products is the logical result of high ideals consistently maintained.

At every stage of manufacture, Wyman-Gordon forgings are subject to rigid inspection and tests, guaranteeing a perfect product.

Engineers and manufacturers are invited to consult with us in reference to any of their forging problems.

Wyman-Gordon Co.

WORCESTER, MASS. CLEVELAND, OHIO

GUARANTEED FORGINGS

"NORMA" PRECISION BALL BEARINGS

(PATENTED)

Day - in - and - day - out dependability never counted for so much—never was worth so much—never was so sought after—as now. To be ready at all times with the full measure of service—to be capable, if need be, of the super-effort that emergency may demand—can any small price-difference be considered for a moment, beside this?

"NORMA" Precision Bearings, in the high-grade ignition apparatus and lighting generators that are rendering maximum service today, are potent factors in the consistent performance which makes these accessories to be preferred where dependability is sought.

Be SURE—See that your Electrical Accessories are "NORMA" Equipped

THE NORMA COMPANY OF AMERICA

1790 BROADWAY NEW YORK

Ball, Roller, Thrust and Combination Bearings.

JULY 15, 1918

AVIATION AND AERONAUTICAL ENGINEERING

VOL. IV. NO. 12

Member of the Audit Bureau of Circulations
Member of the Associated Business Papers, Inc.

INDEX TO CONTENTS

	PAGE		PAGE
The First American Handley Page	857	Novel Ideas in Airplane Construction	872
The A. E. G. Twin Engined Bomber, G105	863	Digest of the Foreign Aeronautical Press	873
Balsa Timber in Costa Rica	871	News of the Fortnight	877

THE GARDNER - MOFFAT COMPANY, Inc., *Publishers*
120 WEST 32D STREET, NEW YORK
WASHINGTON OFFICE, 310 EVENING STAR BUILDING

SUBSCRIPTION PRICE: TWO DOLLARS PER YEAR. SINGLE COPIES FIFTEEN CENTS. CANADA AND FOREIGN: TWO DOLLARS AND A HALF A YEAR. COPYRIGHT, 1918, BY THE GARDNER-MOFFAT COMPANY, INC.

ISSUED ON THE FIRST AND FIFTEENTH OF EACH MONTH FORMS CLOSE FIVE DAYS PREVIOUSLY. ENTERED AS SECOND-CLASS MATTER, AUGUST 3, 1916, AT THE POST OFFICE AT NEW YORK, N. Y., UNDER ACT OF MARCH 3, 1879.

EFFICIENT AERIAL NAVIGATION DEPENDS UPON

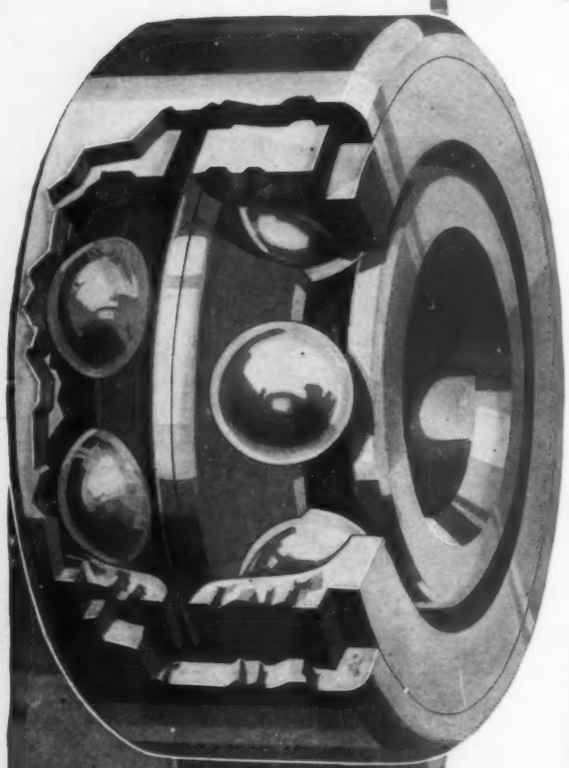
Aeronautic Instruments
of
Accuracy and Precision

SPERRY - GYROSCOPE - COMPANY
MANHATTAN - BRIDGE - PLAZA
BROOKLYN - NEW - YORK
U - S - A

LONDON
15 Victoria St., N. W., 1

PARIS
126 Rue de Provence

IMPROVEMENT



There's a deeper reason than that!

"We'll grant that ball bearings are the ideal equipment for our machines.

"We'll grant that the New Departure Double Row is the proper type—replacing three ordinary bearings; tamper-proof, permanent adjustment, double purpose—taking thrust as well as radial load and stresses successfully, etc.

"Our decision then hangs on this point: *What's the material*—the final test of endurance? **Chrome alloy steel!** That fact fixes the New Departure at once as my choice and assures us of a trouble-proof mechanism.

"Gentlemen, we can do no better."

New Departure Ball Bearings

W. D. MOFFAT
PRESIDENT
W. I. SEAMAN
TREASURER

AVIATION
AND
AERONAUTICAL ENGINEERING

H. M. WILLIAMS
MANAGING EDITOR
LADISLAS D'ORCY
ASSOCIATE EDITOR
GEORGE NEWBOLD
BUSINESS MANAGER

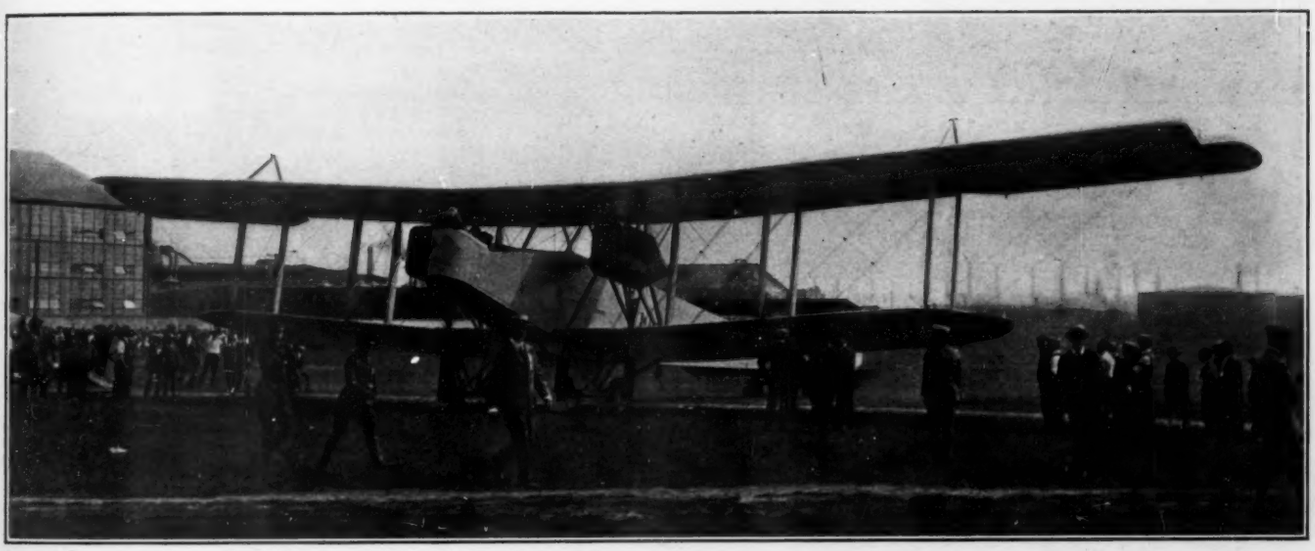
Vol. IV | July 15, 1918 | No. 12

The First American Handley Page

During the past year the Standard Aircraft Corporation has covered practically the entire range of military types of airplanes, from the primary training machine to the large Caproni and Handley Page bombers. The intermediate types include an advanced training machine fitted with a Hispano-Suiza Engine, the M-Defense Scout with a Gnôme Engine, and the D. H. 4 combined reconnaissance, day bombing, and defensive fighting machine. The advanced training machine is the same type as the primary training machine with certain refinements and changes in the front end for the Hispano-Suiza Engine. The M-Defense successfully passed its first official tests without changes, on being demonstrated before officials at Washington at the Polo Field. The primary, advanced training, and scout machines are all from designs by Charles H. Day, Chief Engineer of the company.

The Standard company is the first in this country to complete either a large Caproni or Handley Page bomber. All production and engineering matters were left in the Standard company's hands. The Caproni was started on January 25 and left the plant the first week in May. The trial flights were delayed for six weeks, awaiting the receipt of Liberty Engines of more recent production numbers. The first flight was made July 4, and was successful in every respect. An interesting comparison between the two large bombing machines is afforded by the fact that the three-engined Caproni carries ten pounds to the horsepower, while the Handley Page two-engined machine carries twenty pounds to the horsepower. The fact that these two large foreign machines were reproduced in an American plant under American production methods in less than schedule time, and that they were 99 per cent perfect the first time they flew, is a performance which speaks well for the production of these types in sufficient quantities.

The main object of the public flights of the Handley Page at Elizabeth on July 6 was to visualize for the men and women employes of the Standard company what their splendid work and cooperation had accomplished, and to serve as an inspiration for the future. The enthusiasm of the workers who took in the speeches, the christening ceremony, and witnessed the flights was ample evidence that a good idea had been translated into performance.



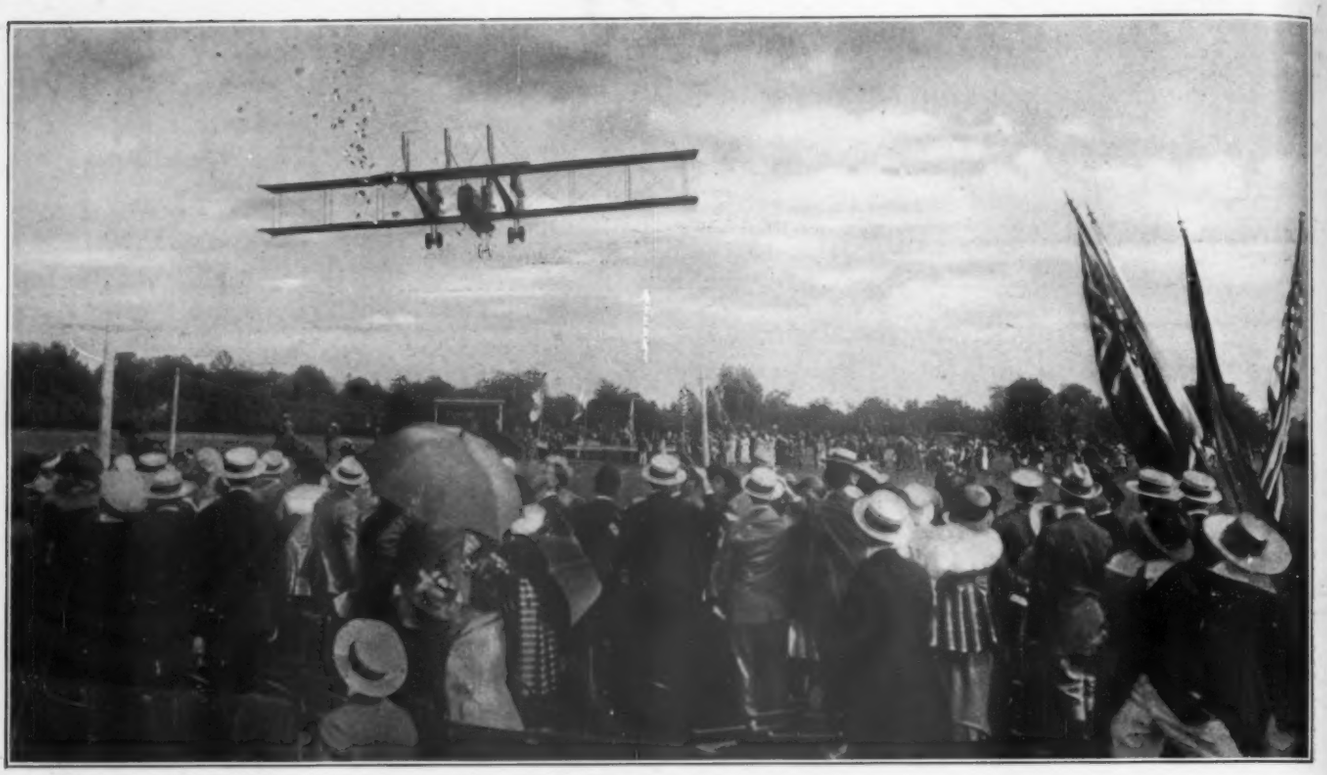
TESTING THE ENGINES OF THE LANGLEY PRIOR TO ITS FIRST FLIGHT

Central News Photo Service

At the same time the invited guests, officers of the Army and Navy, and Government officials, as well as the large number of citizens who witnessed the events from the side lines, carried away with them strong impressions of the magnitude of this country's efforts in the air, and a better perspective of what could be reasonably expected in the future.

The occasion also served to present in its proper light the magnitude of the proposition which has recently been given exaggerated publicity in the press, of building 10,000 Handley Page machines with which to bomb Germany off the map. In these statements it has been pointed out that the type of Handley Page completed by the Standard Aircraft Corporation was an obsolete model, dating from 1915. Definite information secured from representatives of the British War Board now in this country, Handley Page engineers, and an American officer who has just returned from a visit to the Handley Page works in England, places an entirely different aspect on these exaggerated statements.

The new airplane is an O-400 type, which had only been put in production by Handley Page early in April of this year. This machine is only sixty days behind the British production of similar types. The difference between the twin-engined O-400 type and the super-Handley Page is only the difference between the carrying capacity of two automobile trucks. The O-400 is now in production in England and it is



FIRST FLIGHT OF THE AMERICAN-BUILT CAPRONI BOMBER
Photo Western Newspaper Union

a type which Handley Page himself is urging for production in large quantities both in that country and in America, as a thoroughly efficient type for its particular work. It has a range from 550 to 600 miles, and carries 2,000 pounds of bombs. Its gross weight without bombs is 11,791 pounds, with a speed of from 80 to 90 miles per hour. The following facts will perhaps help to an understanding of what the production of 10,000 Handley Page machines would mean:

One of these machines equals 60,000 man hours for production. Ten thousand would equal 600,000,000 man hours. Accounts given out under inspired auspices have stated that 10,000 of the super Handley Page machines could be delivered in ten months. For the smaller or O-400 type, 10,000 machines in ten months represents 60,000,000 man hours per month, or 2,000,000 man hours per day. On the basis of an eight-hour day it would require 250,000 skilled machanics to do this work. The best available estimates show that there are now not more than 10,000 skilled airplane mechanics in the United States and Canada. The size of the non-existent plants to accommodate this many skilled workmen can be imagined.

A production schedule for the O-400 type would call for 10,000 feet of lumber per plane. Allowing for the great waste due to the size and quality of the spruce, bass, and poplar which is now available, this 10,000 feet of lumber per plane would cut down to 1,800 feet of finished material, and would mean dimensioning, cutting, seasoning, and kilning of 100,000,000 feet of some kind of lumber. This country is now trying to cut a maximum of 10,000,000 feet of airplane lumber per month. The kiln capacity of Grand Rapids, Mich., the largest center for this work, is about 500,000 feet in two weeks. The kiln capacity of the entire industry is approximately 100,000 feet per day.

A great deal of special steel tubing is used in the Handley Page machine. Tubing of the required quality is available from practically only one mill in this country. To build up the necessary heat treating facilities, to secure the punch presses and other special facilities for producing 10,000 Handley Page machines would run into years rather than months. To complete such a program in its entirety would probably take five years, and would necessitate laying aside the entire program for American-built combat planes. The main fitting of the Handley Page is "a jeweller's job." The metal fittings are worked to 1/2,000 of an inch, while the woodwork calls for a tolerance of 1/100.

Factory Capacity

Anyone familiar with the size of the Standard Aircraft Corporation's plant will get a better perspective when they appreciate that to turn out one complete Handley Page O-400 per day after six months' intensive preparation would be an excellent performance for the Standard company, or any other company of the same size, including the work of innumerable sub-contractors.

The first Handley Page produced there was completed ninety days after the start, upon a predetermined schedule, which is a performance which has not been duplicated for speed in England. The machine had its first flight on July 1 in a pouring rain, and the interval between rolling the machine out of the hangar and its leaving the ground was only five minutes. The drawings were received on March 29. The work was actually begun early in April, and from 125 to 150 men were employed on the machine in three shifts of 8 hours a day. Very few changes were necessary in this machine; in fact, no major changes beyond those necessary in substituting Liberty engines for Rolls-Royce, and designing and installing new fuel tanks. Practically the only major delay was caused by lack of information for installing the Liberty engines.

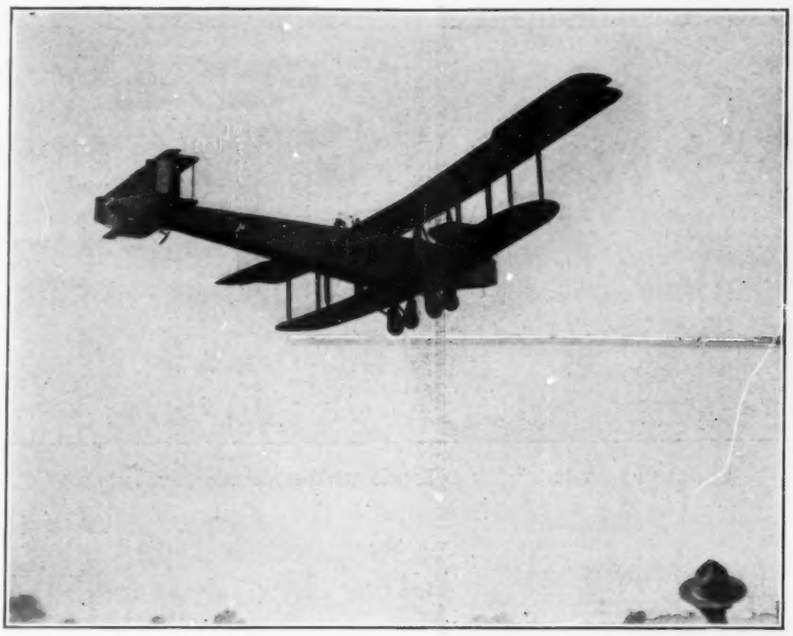
Young P. Dawkins, supervisor of Handley Page production for the Standard company, who had entire charge of the job, was a passenger on the first flight on July 1. In describing this flight Mr. Dawkins said:

"Outside of my first thrill and elation in flying in this first big machine my only other impression when I looked down from a height of 3,500 feet was one of intense satisfaction in the knowledge that we had met the most exacting material specifications I have ever seen, and this gave me a feeling of absolute confidence on my first airplane flight."

It was pointed out that the keen interest and cooperation of parts and accessory manufacturers on this work was of the greatest assistance in putting it through on time. Some metal parts were actually shipped by express in trunks. In other cases messengers were sent with handbags full of metal parts. The Mullens Company of Salem, Ohio, during the severe cold weather and railroad tie-up last winter, sent steel billets across the country by automobile through snowdrifts to the rolling mills. The Torrington Company at Torrington, Conn., made several important shipments of metal parts in trunks by express, as the personal baggage of their messengers, in order to avoid the then existing interminable delays of the freight

shipments. Both the Excelsior Motor and Manufacturing Company of Chicago and the Saxon Company of Toledo shipped parts to the Standard company at Elizabeth in handbags by messengers.

The O-400 Handley Page is capable of making the trans-Atlantic flight via the Azores, by replacing the bomb gear and load of explosives with additional gas tanks. This is the opinion of W. A. Chamberlain, representative of the British Air Board, and Assistant Works Manager for the Handley Page company. The first 40 Handley Page machines were turned out under Mr. Chamberlain's direct supervision. With his staff of five men, who accompanied him from England, Mr. Chamberlain has been the Handley Page representative on the Standard job. He considers the work accomplished by the Standard company an exceptionally creditable performance, both in the matter of time and workmanship. The workmanship, he stated, was better than the first similar English job. Mr. Chamberlain emphasized the uniform courtesy and cooperation extended to himself and his staff by the Standard organization. The pilots who made the tests were Colonel Lord Semphill and Captain E. B. Waller, both of the British Royal Air Force. Captain Waller took the Langley up on its second flight. He states that it handles just as satisfactorily as the British model, and that he is fully satisfied with its performance. Captain Waller took the second Handley Page to France, and has made many flights with this type at the front. He was the sixth man to fly a Handley Page machine, and states that the first ship of this type reached the front in November, 1916.



THE LANGLEY IN FLIGHT
Central News Photo Service

The Langley, first of a lot of Handley Page bombing airplanes, entirely made in an American factory, equipped with two 400-hp. Liberty engines, took the air in its premier official flight Saturday afternoon, July 6, at the aviation field of the Standard Aircraft Corporation, near Elizabeth, N. J.

Aeronautical Experts Present

Gathered at the field, as guests of the builders, were John D. Ryan, chairman of the Aircraft Board; Howard Coffin, former chairman, who is lending all of his experience and knowledge to the new régime; Archer A. Landon, chief of the Production Division, Bureau of Aircraft Production; Major-Gen. William L. Kenly, Director of Military Aeronautics, N. A.; Col. H. H. Arnold, chief of the Intelligence Division of the Air Service; Col. E. A. Deeds, formerly of the Aircraft Board; Naval Constructor J. C. Hunsaker, U. S. N.; Senator Joseph S. Frelinghuysen of New Jersey and Senator Charles S. Thomas of Colorado, both members of the Committee on Military Affairs and the sub-committee which is investigating the aircraft situation; Lieuts. Henry C. Kenly and William L. Kenly; Assistant Secretary of State Benedict Crowell, Sir Henry Fowler, of the British Air Ministry; Gen. William Brancker, R. A. F., Controller-General of Equipment; Lieutenant Cabot, U. S. N. R.; Grover C. Loening, Lieutenant Belloni, R. I. F. C.; Lieut. Ugo D'Annunzio, R. I. F. C.; Sub-Lieut. Constantin Soulier, French F. C.; Capt. E. T. Waller, R. A. F.; Capt. E. L. Austin, R. A. F.; D. W. Brunton, C. R. Whitney and L. H. Barkland of the Naval Construction Board; Lieut.-Commander H. L. Dyer, U. S. N.; Lieut. R. D. Kirkpatrick, U. S. A.; Brig.-Gen. J. D. Cormack, U. S. A.; Lieutenant Oris, U. S. A.; V. A. Smart, British Consul-General; Major Rose, U. S. A.; Major Frank E. Smith, U. S. A.; E. A. Sperry and A. L. Riker, Naval Construction Board, U. S. N.; Sir Henry Tonte, of the British Air Ministry; Capt. E. B. Walls, of the Canadian Army; Lieut. H. Gell and hundreds of others prominent in Government and aircraft circles.

The O-400 Handley Page is capable of making the trans-
Over all wing span, 100 feet.
Lower wing span, 70 feet.
Weight less bombs, 11,791 pounds.
Speed, approximately 90 miles per hour.
Two 400-h.p. Liberty engines.
Bomb carrying capacity, 2,000 pounds.
Over all height (folded), 17 feet 6 inches.

Constructed in ninety days.

Ceiling, 10,000 feet.

First airplane in the world to be formally christened.

First pilot, Col. Wm. Semphill (Lord of Semphill).

At 3.30 the machine was wheeled out of the hangar in which it rested with wings folded and placed in position near the speakers' stand at the southwestern end of the grandstand.

Crowell Speaks

President Mingle opened the ceremonies by outlining the construction of the machine, paying warm tribute to the energy and fidelity of the Standard Aircraft Corporation employes, and introducing as the first speaker Benedict Crowell, Assistant Secretary of War. Secretary Crowell said in his address:

"I am here as the representative of the Secretary of War, who was greatly disappointed at not being able to be here himself to address you on an occasion so important in this hour of war. Secretary Baker fully expected to be here, but important matters concerning Russia made it impossible for him to leave Washington today, and so I am here in his place.

"And speaking of the war, I think that we have all, everywhere in America, reached a position today of great confidence in the ability of our country to go through with the great task that is ours. There is just one American policy now. We are in this war and we are going to stay in until it is won. Today we are planning as far ahead as 1921, although we of course hope that the war won't last that long. But no matter if it lasts until 1921 or long after that, we will be there at the finish.

"We must not become overconfident. The Germans have suffered from overconfidence and so have the Allies on many occasions, and the United States must guard against it, and I am sure we will. The Germans were overconfident in 1914 and they are beginning to realize it now. An example of German overconfidence was what happened in Hoboken just before we entered the war. When the danger of American intervention in the war was evident the crews of all the German ships in that port tried to give us as much trouble as possible, and they thought they had sufficiently wrecked their ships to render them useless to us when we did come in.

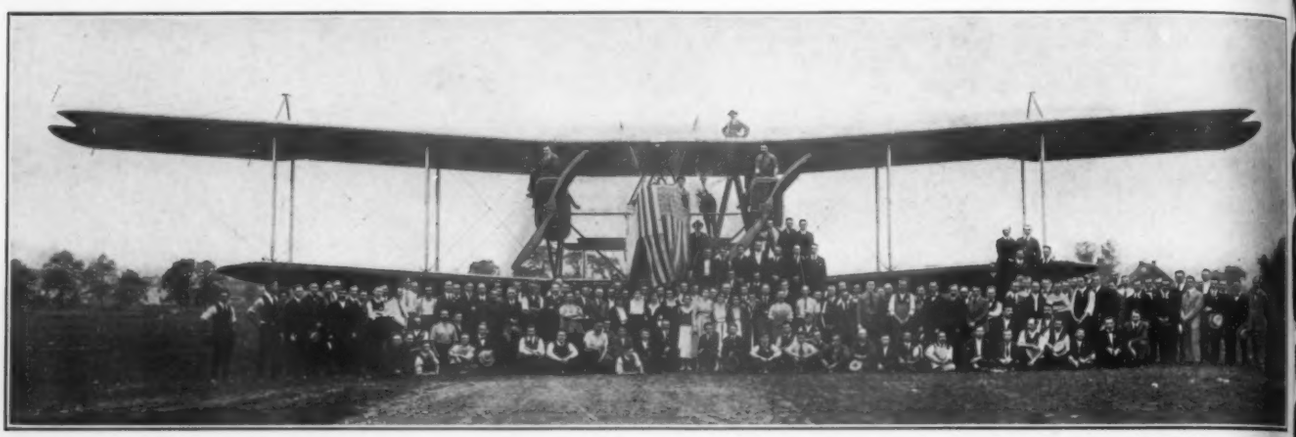
"They figured in the case of the Fatherland, now the Leviathan, that she was a ship of such complicated construction that we would never be able to put her upon the seas, and yet in four months the Navy had the Leviathan ready to sail and she has been making quick trips across the Atlantic ever since, carrying 10,000 men on every eastbound voyage. The Leviathan is a splendid example of overconfidence on the part of Fritz.

"Now, a word as to the aircraft program and this day particularly. The Standard Corporation has done a wonderful job, and to you workingmen and workingwomen who have made that job possible, I want to say that this war is going

to be won by the men and women behind the machines in the United States. Our aircraft program is going forward and it will gain impetus as the days pass. And I am confident that the men and women behind the machines will stand to their colors to the victorious end of the great war."

Sir Henry Fowler's Remarks

Sir Henry Fowler, Deputy Director of Aircraft Production of Great Britain, followed and said he regarded the completion of this plane "as an earnest of the work that is going to be done in other parts of the United States to build up our ascendency in the air.



GROUP OF THE STANDARD EMPLOYES WHO BUILT THE LANGLEY

"We are going to have an overwhelming superiority in the air," Sir Henry said, "and one of the things that will win it is the finest aeronautical engine ever built—the Liberty. No engine was ever more truly named. I have just made a tour of all the factories where the Liberty engines are being built, and although we wish they had come along a bit faster, we are delighted with the work that is being done."

Chairman Ryan's Address

President Mingle then introduced John D. Ryan, Chairman of the Aircraft Board, whose words of encouragement were repeatedly applauded. He said:

"It is a matter of great pride to me to be here today and to witness the launching of this splendid machine, an airplane that is British in design and American in construction. The raw materials were all grown in America, the engines were built in America, and the men and women who did the building are Americans. The launching of the machine is an earnest of what the United States is going to do in the future to promote its aircraft program.

"This airplane is one of the most powerful ever built. It is a type of plane that is driving the Hun behind his own lines, the kind that is keeping him there, and also the kind that is destroying the things behind his lines on which he depends to defeat our boys and those of our allies. And I am glad to tell you that thousands just like this one are under construction, all to be driven by the Liberty engine, the best and the most powerful aeronautical engine ever built. We are now furnishing Liberty engines to our own airplane manufacturers, and England, France, and Italy have called on us to furnish Liberty engines to them for installation in their own planes. The production of the airplane in quantity is easy, but that of the airplane engine is another matter. The number of airplanes in the last analysis is the number of engines to drive them.

"There has been great dissatisfaction expressed by the people of the country at the results attained up to the present in the production of aircraft. Some of it has been warranted—most of it has been caused by expectations beyond the possibility of performance.

"I can speak with knowledge on this subject because I have for two months studied every cause of delay and disappointment, and I can speak freely, because no stretch of my conscience will let me claim any credit for what has been done up to the present day. My connection with the work of aircraft production for the army has been so short that nothing I have done or left undone could possibly have affected the accomplishments at this time.

"Much good work has been done by my predecessors, and I am taking this opportunity to assure the people of the country that, in my opinion, there has been no such delay with the work or anything like such incapacity of those in charge as has been indicated in some of the criticism of the accomplishments, or lack of them, in production. A few facts will, I think, bear me out.

"In the fifteen months we have been at war there has been designed and put into production the Liberty engine, which is acknowledged by all of the Allies as one of great performance and a distinct contribution to the cause. As a powerful ma-

chine to drive heavy aircraft, it is undoubtedly as satisfactory as any engine produced by any nation on either side of the war. There were produced here in our workshops during the months of May and June just past as many of these engines as Great Britain produced of all types of aeronautical engines in the entire year of 1915, at the close of which she had been seventeen months at war. Including other types of aircraft engines, there were more produced in our shops in the month of June than Great Britain produced in the whole year of 1915.

"The representatives of Great Britain's Air Ministry here today have verified these facts, and consider the performance very satisfactory in view of the fact that prior to our entrance into the war almost nothing had been done here except by private enterprise to prepare for aeronautical engine design or production.

"The limiting factor in our production program, as in that of every nation in the war, is engines. The planes proper can be made in any number required, but no nation has yet been able to furnish engines in the quantities needed. All the Allies are today looking to us—calling to us—to furnish Liberty engines to drive their planes and promote their air programs. Two of the best of foreign types of engines have been put into production here in quantity, and are now going overseas to drive planes being built in France and England for our air forces, as well as being supplied for planes we are building here to be shipped abroad.

"We have in course of development another foreign engine of high power, and facilities have been provided for its production in quantity. We are now loading on almost every ship sailing for France large planes equipped with engines and every accessory to fit them for service as soon as they can be assembled on the other side. We have in order and in production a large number of planes of the type you saw flown here today, and the other proven types of large fighting planes are being started in production.

"The people of the country have been carried away with the talk of tens of thousands of fighting and bombing airplanes, and have been impatient when they have heard of the few we have produced so far. There never have been 10,000 airplanes on either side of this war at any one time, and until within a month, if even now, there have not been 10,000 on all sides and all fronts of the war added together.

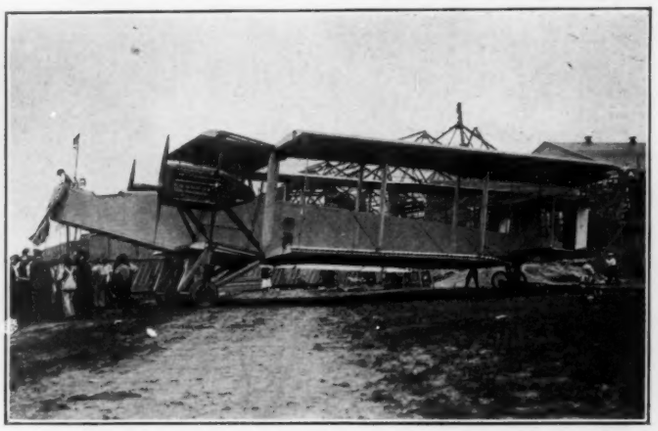
"We must learn to think and talk of things we want to win with in the quantities that can be furnished and in the time required to furnish them. We will have aircraft in type, in quantity, and quality to accomplish what we have set out to

do—to win the war. We have set that as our mark and in the way of our progress there may be delays and disappointments—but no failure. The men and women who are bending their efforts to make our air forces supreme will have the reward of victory—victory in the air and in the war.

"Our allies have secured and maintained supremacy in the air, and America will add to that such preponderance that no doubt may be felt of the result we have set ourselves out to attain.

"The facilities for the manufacture of aircraft engines and planes are being developed with all speed and skill available—that we now have entered the production stage gives assurance that the country and its allies will soon realize the benefit of such a fighting air force as will satisfy our people and bring consternation and defeat to our enemies."

THE LANGLEY BEING WHEELED OUT OF ITS HANGAR



THE LANGLEY WITH WINGS FOLDED

Meantime two Curtiss training machines arrived from Hazelhurst Field, Mineola, L. I., driven by Major Rinehart and Captain Hawley. One of them had General Brancker as a passenger.

General Kenly Applauded

Maj. Gen. Wm. L. Kenly, Director of Military Aeronautics, was the next speaker. He faced the grouped Standard employes and said:

"It is my pleasure to congratulate you on turning out the first Handley Page ever built in America. I consider it an honor, as head of the Department of Military Aeronautics, to accept this splendid machine. We appreciate thoroughly what you are doing for your country, and I am happy to inform you that we are now ready to fly and fight all the machines that can be turned out in the United States."

Gen. Kenly's brief remarks were applauded vigorously. Those who heard him needed no stretch of imagination to be convinced that he is a fighting man.

Following General Kenly came General William Brancker, R. A. F., Controller General of Equipment, of the Royal Air Force. Resting his arms on the rail of the speakers stand General Brancker, who is an excellent speaker, said:

"We in Europe, France, Belgium, Italy and England, have been fighting for nearly four years now. Throughout that period we have maintained superiority in the air, but the strain has been great, and we cannot go much further. Neither can Germany go much further, and for the same reason.

"In America you have resources that are unlimited. Than your aviators there are none better. I have seen them in England and in France, and I speak with first-hand knowledge. We are now trying to build up an air force which will carry the war into the very vitals of Germany, and the type of machine which is destined to cross the Rhine is the type you see before you here.

"And now a word about the Liberty engine. It has been much criticised. In England we have been backing it for nine months, and we are building a big program, and in those machines we are using the Liberty engine. I have a cable in my pocket now which will make our American comrades tremble, for in that cablegram I am delegated to ask them to let us have still more Liberty engines, and have them before the end of this year. The Liberty engine is a success. You may be assured of that.

Samuel P. Langley, a nephew of the late Prof. Samuel Pierpont Langley and the nearest surviving male relative of the man who is generally regarded as the father of aerodynamics, for whom the Handley Page bomber is named, was the next speaker. Among other things he said:

"The subject of flying had been of interest to Prof. Langley throughout his life, but it was not until 1887 that he began to give it serious thought. In that year he constructed at the Allegheny Observatory a turntable operated by steam power which furnished the air currents for a series of experiments and studies on the lifting force and resistance of various plane surfaces set at different angles. The results were recorded in 'Experiments in Aerodynamics' published 1891 by the Smithsonian Institution, and 'The Internal Work of the Wind' published in 1893. These publications gave to physicists perhaps for the first time firm ground on which to stand as to the long-disputed question of air resistance and reactions.

"These studies were more elaborate, more profound, and more instructive than those of any of his contemporaries and predecessors, and they proved to be of immense value to Messrs. Chanute, Wright and others who continued the work where he left off. Prof. Langley now undertook to apply this knowledge practically to the problem of actual flight. For this purpose he built, during 1891-1895, four model flying machines, one driven by carbonic acid gas and three by steam engines. He encountered a series of disappointments and failures, of which he has given an interesting account in the 'Aeronautical Annual' for 1897, but on May 6, 1896, he had the satisfaction of seeing his 'Aerodrome No. 5' fly a distance of about 3,000 feet on the Potomac river. This was followed by the successful flight of another aerodrome on Nov. 28, 1896.

"These experiments in flying having attracted the attention of the Government, recommendation was made in 1898 that a full size man-carrying machine be developed for war purposes. The War Department appropriated $50,000 for the purpose. This machine was equipped with a gasoline motor of 52 hp. The flying weight of the machine complete with the aviator aboard was 830 pounds, its sustaining surfaces were 1,040 sq. ft. and it was intended to be launched from a catapult placed on the deck of a houseboat, precisely in the same manner as his previous models. Attempts were made to launch this machine with Charles M. Manley as pilot on Oct. 7 and Dec. 8, 1903. Both trials were failures in consequence of a defect in the launching gear. The press, not knowing all of the facts, cast ridicule on the experiment and decried such useless expenditure of public money, so additional appropriations were refused. It thus happened that Langley with success in sight, was finally defeated and deprived of the opportunity to be the first to achieve dynamic man-flight in the air."

The Official Flight

At 4.10 Mrs. Mingle, wife of the President of the Standard Aircraft Corporation, entered the speakers stand, and, while the employes' band played the "Star Spangled Banner," and "God Save the King," christened the machine "Langley." After this ceremony the machine was wheeled out in the field amid the wild cheers of the spectators, who now numbered more than 5000, mostly from Elizabeth and surrounding towns.

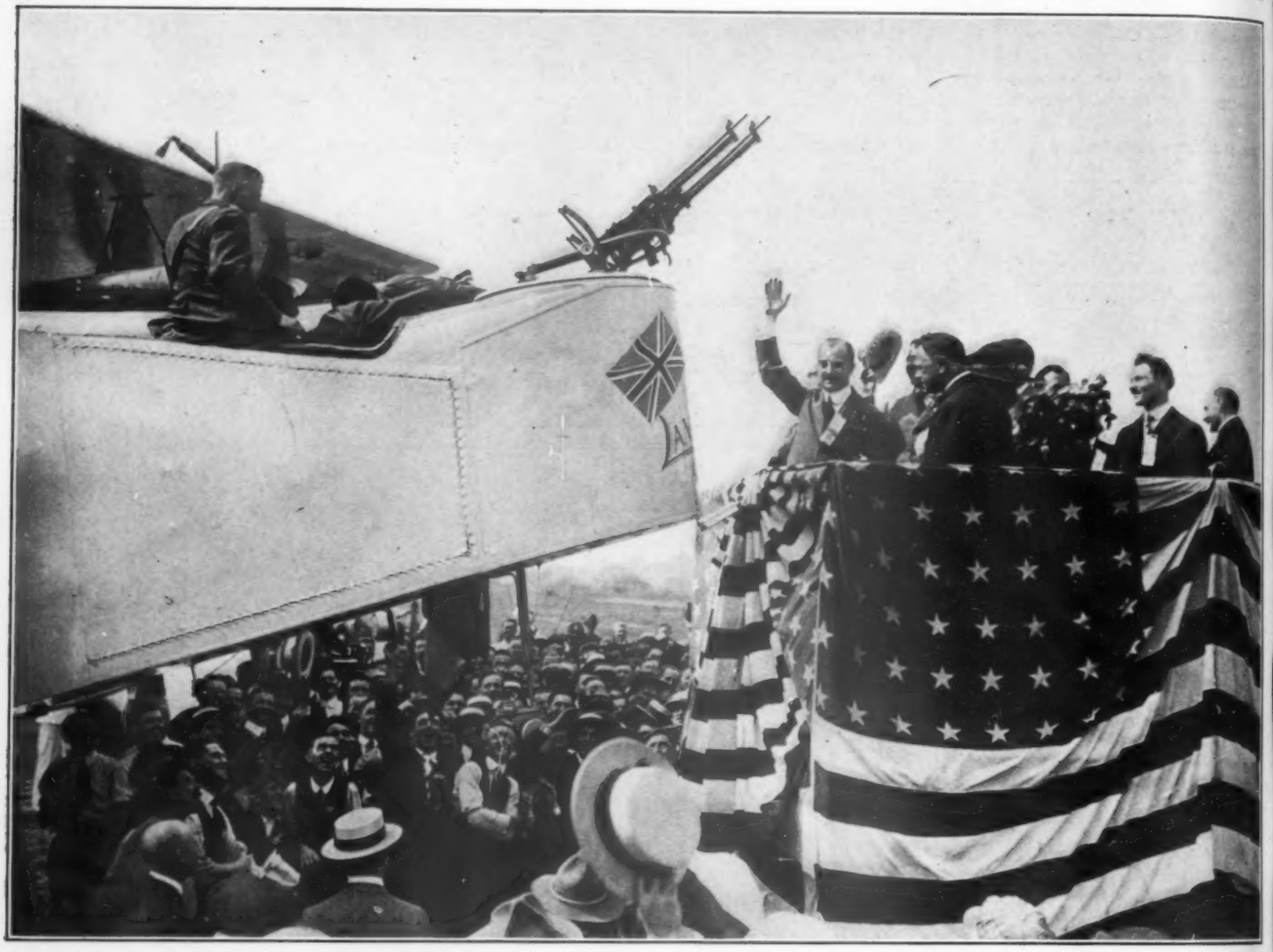
In the Langley were seated the pilot, Col. William Semphill, Lord of Semphill, R. A. F., General Kenly, Director of Military Aeronautics, Capt. E. T. Waller, R. A. F., Young P. Dawkins, Supervisor of Construction for the Standard Aircraft Corporation and a moving picture operator for the Committee on Public Information.

Exactly at 4.30 the pilot started the Liberty engines. The propellers began to whirl, and the airplane started taxying across the flying field. General Kenly waved his hand at the crowd in the grandstand. Colonel Semphill did the same. For perhaps one hundred yards the Langley skimmed the earth, and then, like a mighty bird, it left the ground.

When he had reached an altitude of about 3,500 feet Colonel Semphill swung to the south and then, slowly turning, headed east again directly over the field and above the thousands of cheering people. Half a dozen times the bomber circled back and forth over the field, first at great heights and then at low altitudes. The bomber was maintaining a speed of approximately 90 miles an hour. The motors were working with the precision and regularity of a chronometer.

At 4:55 o'clock the crowd noted that the bomber was coming down. The landing was perfect and the skillful handling of the Langley was much admired by the experts when its pilot taxied across the field until the nose of the big bomber nearly touched the reviewing stand whence it had started.

"A magnificent performance," said Secretary Crowell, as he watched the bomber taxying over the ground, and the aviation officers indorsed the sentiment.



PRESIDENT MINGLE GIVING THE PARTING SIGNAL JUST AFTER THE CHRISTENING

Book Review

AIRCRAFT IN WAR AND COMMERCE.. By W. H. Berry. (*George H. Doran Co., New York.* $1.50. 292 *pp.*, 26 *ill.*)

This book has the great merit of affording the large class of public that is interested in aeronautics but generally kept from its various phases by the wholesome respect technical and pseudo-technical works elicit from the lay mind, a strictly popular treatise of facts relating to the present status of aircraft, its effects on the art of warfare, and its future prospect in peaceful pursuits.

After giving a historical summary of the airplane's development up to the war, the author comes to dwell upon the work accomplished by aircraft in warfare, paying particular attention to the airplane, but devoting also a chapter to the use of the airship and the seaplane. Other chapters give a general description of aero-engines and accessories, and one is set aside for dealing with the problem of aircraft raids. The latter chapter contains a reference which seems to warrant it being quoted:

"A present-day submarine could house half-a-dozen seaplanes by a little readjustment of internal arrangements, and half-a-dozen such craft could unload a very destructive air fleet for an attack on New York without exposing itself to any greater danger other than the Allied naval defensive against submarines. Within an hour's flight of New York the seaplanes could emerge and the bombs carried by the aircraft would be much heavier and far more destructive than those used in the attacks against London, because there would be no need for the aircraft to carry gasoline for an extended flight. Several trips could be made in the course of one night, the machines returning to their submarine base and replenishing bombs and fuel as required, and there would be a distinct possibility of the aircraft escaping without serious casualties."

The A.E.G. Twin-Engined Bomber, G.105*

An A.E.G. twin-engined bomber, G.105, was brought down by anti-aircraft fire at Achiet-le-Grand December 23, 1917.

This machine, while carrying a similar power plant, is very different in construction from the Gotha type, which also embraces the Friedrichshafen Bomber.

The latter is generally constructed of wood, ply wood being used to a very large extent throughout, but in the A.E.G. steel is almost universally employed, not only in regard to the body, nacelle, subsidiary surfaces and landing gear but also in the wings themselves.

Needless to say, acetylene welding is freely resorted to throughout the construction, which, however, appears to be far from light.

On the whole, the A.E.G. airplane, judged by contemporary British standards of design, is decidedly clumsy, not only in detail work but also in appearance. The performance is poor.

The leading particulars of the machine are as follows:

Weight empty, 5258 lb.	
Total weight, 7130 lb.	
Upper wing area, 395.2 sq. ft.	
Lower wing area, 335.2 sq. ft.	
Total area of wings, 730.4 sq. ft.	
Loading per sq. ft. 9.77 lb.	
Area of ailerons, each, 17.9 sq. ft.	
Area of balance of aileron, 1.8 sq. ft.	
Area of tail plane, 34.0 sq. ft.	
Area of fin, 11.5 sq. ft.	
Area of rudder, 20.8 sq. ft.	
Balanced area of rudder, 2.6 sq. ft.	
Area of elevators, 31.2 sq. ft.	
Balanced area of elevators, 3.6 sq. ft.	
Horizontal area of body, 206.4 sq. ft.	
Vertical area of body	209.2 sq. ft.
Total weight per hp	13.7 lb. approx.
Crew—Pilot and two passengers	540 lb.
Armament	2 guns.
Engines	2 260 hp. Mercédès.
Gasoline capacity	123 gallons = 861 lb.
Oil	11 gallons = 110 lb.
Water	13 gallons = 130 lb.

Other dimensions are also shown on the drawings.

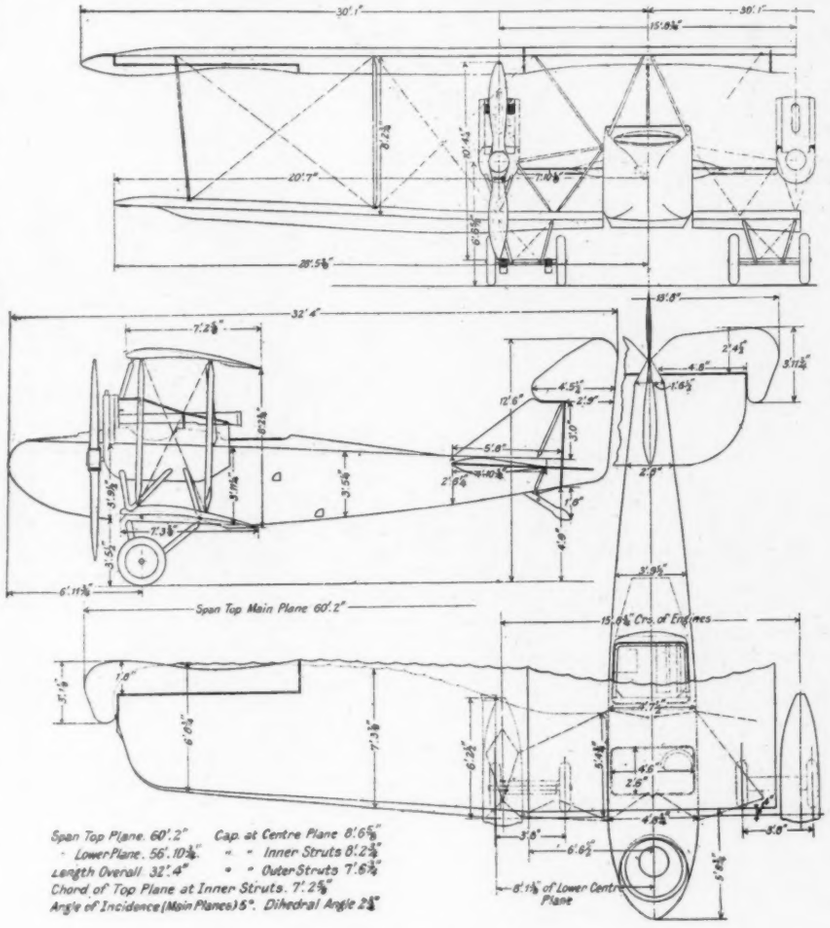

Span Top Plane. 60'.2"
Lower Plane. 56'.10¾"
Length Overall 32'.4"
Chord of Top Plane at Inner Struts. 7'.2⅝"
Angle of Incidence (Main Planes) 5°. Dihedral Angle 2½°
Cap. at Centre Plane 8'.6⅝"
" " Inner Struts 8'.2⅜"
" " Outer Struts 7'.6⅞"
Span Top Main Plane 60'.2"
15'.6⅝" Crs. of Engines
8'.1⅜" of Lower Centre Plane

FIG. 1 SCALE DRAWINGS

Performance

(*a*) CLIMB, 5,000 ft. in 10.3 min.
Rate of climb at 5,000 ft.—390 ft. per min.
CLIMB, 9,000 ft. in 23.4 min.
Rate of climb at 9,000 ft.—235 ft. per min.

(*b*) SPEED AT HEIGHTS
Level to 5,000 ft.—90 miles per hour approximately
At 9,000 ft.—86 miles per hour approximately

(*c*) LANDING SPEED
The airplane is best landed at a speed between 75 and 80 miles an hour; after flattening out it sinks to the ground quickly and pulls up rapidly.

(*d*) CONTROL
1 Lateral—Good
2 Elevators—Bad, especially when landing

NOTE—It is stated that it is not advisable to fly this machine without a passenger in the front seat.

Construction of Wings—As will be seen from Fig. 1, the wings are of characteristic form. The central portion consists of a rectangular center cell permanently attached to the body. The lower wings support the engines. In this center cell the planes are set horizontally. At each side of it the lower main planes are swept upwards with a vertical dihedral of 2.75 deg., the top planes being kept flat, and both main planes are swept backwards in the horizontal plane to an angle of 4 deg. for the bottom plane and 3 deg. for the top plane. As the central portion of the upper main plane has 4 in. of negative stagger relative to the bottom plane, this difference in angle brings their tips practically vertically over one another. The angle of incidence attains a maximum of 4 deg. at the base of the engine struts—*i. e.*, 7 ft. 10⅜ in. from the center. At the second strut the angle is 3½ deg. and at the end strut 2½ deg. These angles are painted in circles on the surface of the planes, evidently for the convenience of riggers. The camber of both planes is washed out gradually toward the tips. The main spars are of steel tube and are 50 mm. in outside diameter, but their wall thickness is not at present known. In order to allow the thinning down of the wing section, these tubes are flattened out toward the extremity of the wing. They are chamfered down to a narrow end and a flat plate acetylene welded on to each side; thus at the spar tip the section is roughly rectangular.

The main spars are kept parallel throughout the whole of their length and are attached to the central cell by means of pin joints, similar to those on the Friedrichshafen. The ribs are of solid wood and are constructed as shown in Fig. 2. It is rather notable in comparison with other German machines of all types that ply wood is almost entirely absent. In the A.E.G. construction the rib webs are perforated and strengthened by wooden uprights at intervals and are glued into a grooved flange. The ribs are placed 300 mm.— 325 mm. apart, and are not directly or firmly attached to the spars, on which they are a relatively loose fit.

Passing through the ribs of the bottom plane and extending from their junction with the center section to the extreme outside strut are two steel tubes, approximately 17 mm. in diameter, which act as housings for the aileron control wires. These tubes are very strong, and it is thought possible that they are also counted upon to lend rigidity to the wing structure. The leading edge, which is of the usual semicircular section, acts as a distance piece, as also does the wire trailing edge. Thirteen inches in front of the last named is a stringer

* Report issued by the Technical Department of the Department of Aircraft Production, British Ministry of Munitions.

formed of a steel rod. Apart from this, the spars are the only longitudinal members of the wings.

Between the main ribs are false ribs running from the leading edge to a point a few inches behind the leading spar and

FIG. 2

applying only to the upper surface. One of these false ribs is sketched in Fig. 3. It is secured by means of a semicircular saddle and a wrapping of tape which passes as shown through holes in the rib. Where it meets the leading edge it is furnished with triangular packing pieces, which locate and hold it in position. The lower plane is covered as to its upper surface with sheet metal immediately under the engines, while between them and the body is fixed a strip of corrugated aluminum which acts as a footway. The fabric is attached in the usual manner and is stitched to the ribs both top and bottom. The two surfaces are stitched together behind the metal rod, which acts as a stringer, and by this means the actual trailing edge wire is relieved of a certain amount of tension.

FIG. 3

The wing structure is internally braced by means of steel tubular cross-pieces and stranded cables. A single fitting is employed for the attachment of the interplane struts and for that of the bracing tubes. This fitting is shown in Fig. 4. It is a tight fit on the spar, to which it is fixed by a bolt, and is formed with an extension lug which acts, as shown, as an anchorage for the bracing tube, whilst a sideways extension of the same lug carries an eye for the bracing wire. It is provided with a cup-shaped upper extension, into which there is screwed a steel dome which carries the ball of the strut socket fitting and also acts as a wiring plate for the interplane bracing wires. As shown in the sketch, the fabric is run into the space between the upper and lower flanges of this fitting, the whole making a very neat job.

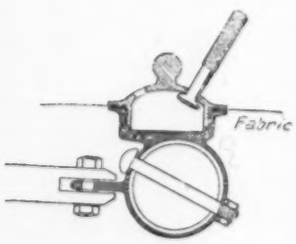


FIG. 4

Struts—These are of streamline section steel tube and of uniform dimensions throughout. The section is 92 mm. long by 48 mm. broad. The ends are sharply tapered down, and into them is welded a cupped ferrule which drops on to the ball shown in Fig. 4 and is there held in position by a cotter pin. The attachment is shown complete in Fig. 5. This joint gives a considerable range of lateral freedom, as is the usual practice on machines of German design.

Body—The whole of the body is built up of steel tubes welded together. It is of plain rectangular section and the cross tubes are attached directly to the main booms without the intervention of any clips. This detail of construction is shown in Fig. 6, which also illustrates the single and double lugs which are used for the purpose of securing the bracing wires. Under the nacelle and in the neighborhood of the main gasoline tanks and the bomb racks the body is reinforced with thin tubular steel tie-rods. Fig. 7 shows the manner in which the upper booms of the body are provided with sockets for the inclined struts of the central cell. The fitting consists of two circular steel plates welded into position to form an integral part of the frame joint, the front one of these flanges being provided with lugs for the anchorage of bracing cables. The inclined struts are secured by a ring of short set screws wired together as shown. If appearances are to be

FIG. 5

trusted this form of attachment, while being strong and convenient, is excessively heavy. Unlike the practice which is pursued in the Friedrichshafen Bomber, wherein the main frame consists of three separate sections, that of the A.E.G. is in one piece from stem to stern. The longerons are 30 mm. in diameter and the transverse members 30 mm., these dimensions being retained up to the extreme tail end. The nose part of the frame is covered in with three-ply wood, but behind this a double covering of fabric is used, under which the tubular construction is completely hidden. Behind the after cockpit a single covering only is adopted and laced the whole of its length so that it is removable in its entirey.

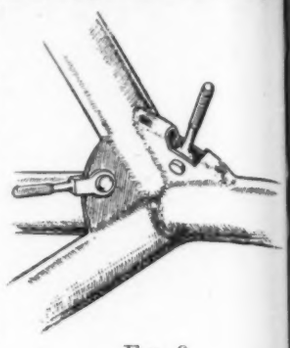


FIG. 6

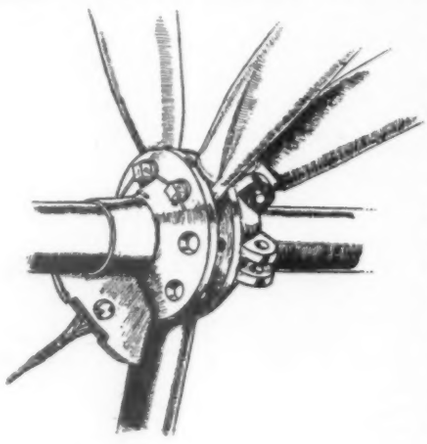


FIG. 7

Engine Struts—These are of streamline steel tubing and embrace joints of a somewhat similar type to those used on the interplane struts; that is to say, a certain amount of free movement is provided. The mounting of the engines is clearly shown in the front and side elevations. In front there are four struts which converge to a joint on the leading spar, while at the rear there are two struts which meet at a joint on the trailing spar. The attachment of the former is shown in Fig. 8. The bell-shaped housing attached to a cup on the spar joint contains a ball-ended set-screw, which screws into the foot of the four struts which are here united by welding. The inclined transverse struts are taken from the spars to the engine mounting and cross struts from thence again to the upper booms of the fuselage. In order to provide simplicity of erection these subsidiary struts are provided with a means of adjustment as shown in Fig. 9. At one end they terminate in a ball-ended set-screw screwed into the tapered end of the strut and secured by a lock nut.

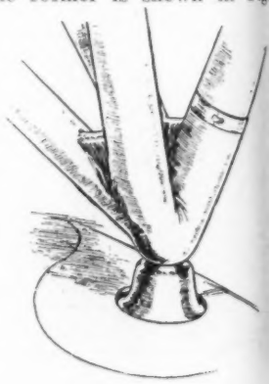


FIG. 8

Engine Mounting—The engine bearers are of steel rectangular section, measuring 40 mm. high by 30 mm. broad, with a wall thickness of approximately 2 mm. These bearers are welded to the struts which support them, as shown in Fig. 10, and for the greater part of their length are reinforced by a system of tubular tie-rods also welded in position. Box attachments welded to the engine bearer, as shown in Fig 11, are provided for the crank-chamber holding-down bolts. The engine is not directly mounted on the steel bearers, but upon ½ in. wooden washers. Owing to the deformation inseparable from so much welding the engine mounting is of very clumsy appearance, and, in fact, the quality of welding does not appear to be up

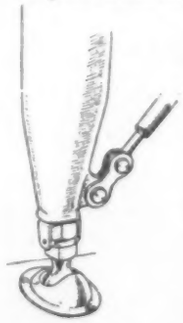


FIG. 9

to previous German standards, but the construction would appear to be light.

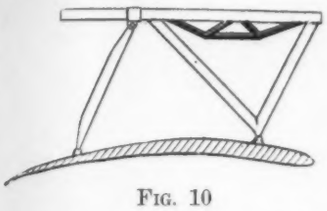


FIG. 10

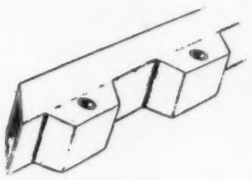


FIG. 11

Engine Fairing—As shown in the photographs, the engines are almost completely enclosed in a fairing composed of detachable aluminum panels. The necessary framework and clips are provided for panels totally enclosing the engine, but it would seem that this bonnet right over the heads of the cylinders has been discarded. The tubular framework which supports the panels is an elaborate piece of work, comprising a multiplicity of welded joints. It consists of 16 mm. tubes, to which are attached lugs for carrying the necessary turnbuttons. The framework is made in two halves so as to be easily detachable, and a joint for that purpose is made, as shown in the sketch Fig. 12. It will be noticed that a narrow slot for the exit of air passing over the engine is provided at the rear end of the engine egg, an opening of somewhat similar dimensions being between the two halves of the radiator.

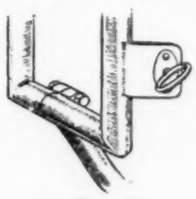


FIG. 12

Engines—The engines are the standard 6-cylinder 260-hp. Mercédès. A new shape has been adopted for the exhaust pipe, and this is clearly shown in Fig. 13—an inverted cone is placed in the belled mouth of the pipe. The usual water pump greaser is fitted and worked by a lever in the pilot's cockpit. It is of rather less clumsy design than that of the Friedrichshafen, but employs virtually the same principle. The throttle is inter-

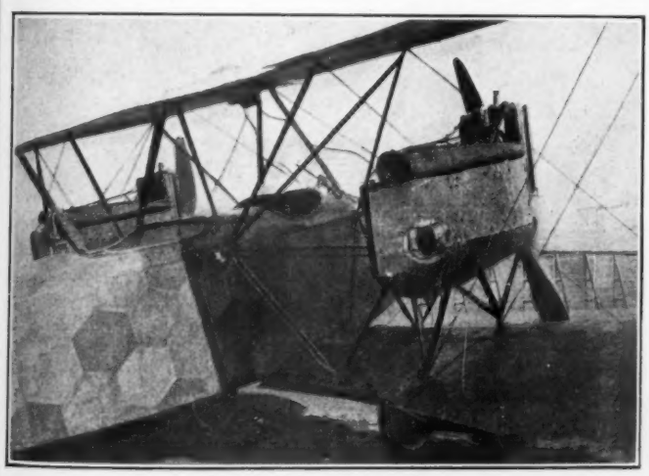


FIG. 13 THREE-QUARTER REAR VIEW OF BODY AND ENGINE MOUNTING

connected with the ignition advance as described in the Friedrichshafen report. A small fitting, the purpose of which is not very clear, is attached to the carbureter, and consists, as shown in Fig. 14, of a bell-shaped cover over the top of the float chamber, not directly connected thereto, but supported on a bracket clipped to the main water pipe. The bell is free to slide up and down the stem of the bracket, on which it is a very loose fit, but is prevented from falling over the float chamber by a small washer. It is conjectured that this fitting may have for its purpose the prevention of fuel having access to the hot exhaust pipe in the event of the machine turning over. Between the bell and the float chamber is a clearance of about ¼ in.

Gasoline System—The gasoline system employed on the A.E.G. is set out diagrammatically in Fig. 15. There are two main tanks, each of 270 liters = 95 gallons total capacity, and these are placed under the pilot's seat in the main cockpit. Two subsidiary tanks used solely for starting purposes and giving a gravity supply are mounted in the center section of the top main plane and are of roughly streamline form. Beneath them is a small cowling containing their level gauges, which are visible from the pilot's seat. On the right-hand side of the main cockpit is fitted a hand-operated wing pump, the object of which is to draw gasoline from either of the main tanks and direct it to the gravity tanks. Pipes from all four tanks are taken to a distributing manifold on the dashboard, and by means of seven taps thereon the supply of gasoline can be directed from any one of the tanks to either engine or both. Two additional taps are provided on the wing pump, so that the fuel for the gravity supply can be drawn from either main tank as required. Fig. 16 clearly shows the arrangement of the gasoline taps, which are of the plain plug type. It would appear that the troubles associated with this form of tap have been overcome, as they show no signs of leaking or sticking. The level of the main tanks is indicated on the dashboard by two Maximall gauges. Those attached to the gravity tanks are made by Laufer and employ the static head principle. They read up to 45 liters each, from zero to this figure being given by one and a half complete revolutions of the indicating hand.

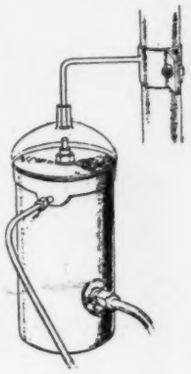


FIG. 14

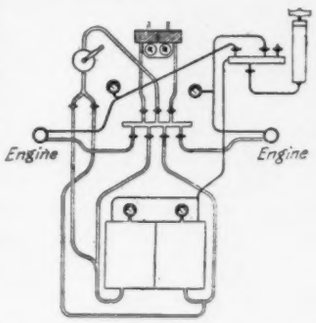


FIG. 15

Gasoline Pressure System—The sketch Fig. 15 also shows in solid lines the arrangement of the gasoline pressure system. The usual pressure pump is mounted on each engine, and pipes therefrom are led to a manifold mounted on the dashboard. This is also connected to a large hand pump on the right-hand side of the pilot's seat. Gauges reading the pressure from each engine pump are provided, and there is also a blow-off tap for relieving the pressure of the whole system.

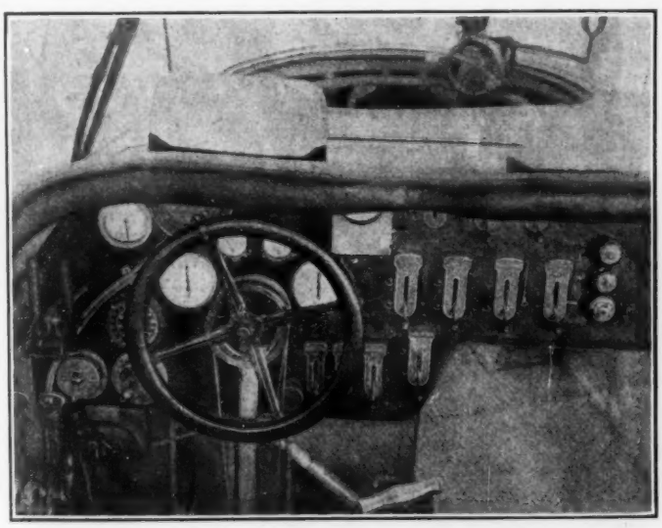


FIG. 16 INSTRUMENT BOARD IN PILOT'S COCKPIT

Oil System—This is the usual system as fitted to all 260-hp. Mercédès engines. The main supply of oil is carried in the crank chamber sump, and is continually being refreshed by a small additional supply of fresh oil drawn from an external tank. This tank has a capacity of five gallons, is of rectangular shape, and is mounted at the side of the engine nearest to

the fuselage. It is provided with a visible glass level, over which is a celluloid covered window let into the engine fairing, so that the oil level is visible from the pilot's seat.

Radiator—Each radiator is composed of two halves bolted together, as shown in the sketch Fig. 17, which is to scale. The space between the two halves is partially covered with a sheet metal panel pierced with a hole 1 ft. 6 in. high by 4 in. wide. The radiator is not actually honeycomb, though presenting that appearance. It consists of a series of vertical tubes with transverse gills. Each radiator cell measures 2 ft. 3¼ in. high by 7½ in. wide, and has a uniform depth of 4 in. Each complete radiator is provided with two shutters of roughly streamline section. These, when fully closed, cover over about one-third of the radiating surface.

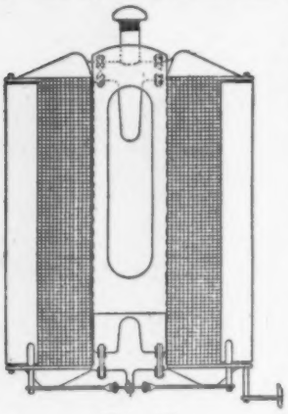


FIG. 17

They are controlled from the pilot's seat by two levers shown in Fig. 18, which work them through universally jointed rods. The articulation in these rods is very neat, and of the form shown in Fig. 19. Each radiator is fitted with an electric thermometer. The dial of this instrument is carried on the dashboard, and is furnished with a switch, enabling the temperature of either radiator to be independently read.

Engine Control — The throttle levers are of the plain twin variety, and are constructed as indicated in sketch Fig. 20. They are placed close together so as to be easily worked either in unison or separately. The connections between the levers and the carbureter are made as simple as possible, and the levers operate the throttle through a couple of universally jointed rods which extend from each side of the body to the engine eggs. The universal joints used are of the type shown in Fig. 21, there being apparently no particular desire on the part of the designer of the machine to economize weight in these details.

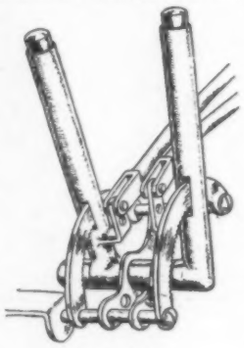


FIG. 18

Tail Planes — The fixed horizontal tail planes are notable for their extremely bold curvature, both top and bottom. The framework consists entirely of welded steel tubing. The leading edge of the tail plane is mounted so as to be adjustable in case of necessity, a simple bracket being used for this purpose, as illustrated in Fig. 22. This is welded on to the body upright at each side and strengthened with a transverse stay. It allows the tail plane leading edge to be fixed in one of three positions. The trailing edge of the tail plane is supported each side by a streamline section steel tubular strut.

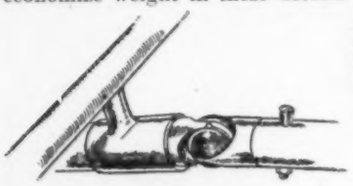


FIG. 19

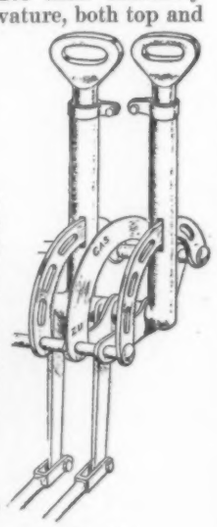


FIG. 20

Fin—The fin, like the fixed tail plane, has also a very strongly marked streamline section at the base tapering off to flat at the top, where it abuts against the balanced portion of the rudder. At this point its framework, which is of light steel tube, is made rigid by a couple of tubular stays bracing the rudder post to the sides of the body.

Rudder and Elevators—These organs are built up of steel tubular framework and present no points of special interest, except that in the case of the rudder that part which is above the fixed fin is made of grooved section.

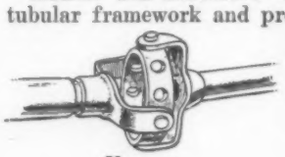


FIG. 21

Ailerons—As may be seen from the plan view of the complete machine, the shape of the ailerons is somewhat unusual. These are applied to the top plane only and have a chord which reaches its maximum at their extreme ends and its minimum in the center of their length. For what purpose this peculiar shape is adopted is not clear. The framework of these ailerons is welded steel tubing, and the control crank is fitted in such a way as to lie partially hidden in a slot in the main plane. This crank is built up of welded sheet steel, and is arranged as shown in the sketch, Fig. 23, an elliptical hole being cut in the trailing edge of the main plane for the passage of the forward wire.

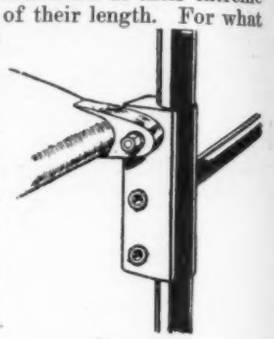


FIG. 22

Control—The main control consists of a wheel mounted on a pivoted lever, the wheel operating the ailerons by means of a drum and cables, which pass direct over pulleys and along tubes running parallel with the wing spars and then over inclined pulleys up to the aileron cranks.

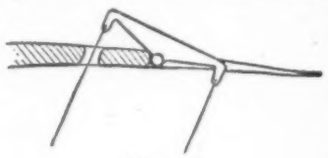


FIG. 23

The wheel column is pivoted to a long crossbar extending the whole length of the body and carrying at each end cranks for the elevator control wires which at intervals are carried through fiber guides socketed to the frame. The cranks of the elevators are concealed inside the rear end of the body, while those of the rudder (which is fitted with duplicate cranks and wires) are external. A modified dual control is fitted, which allows the assistant pilot to work the elevator and rudder only. For this purpose a socket is mounted on the pivot bar into which can be inserted a plain steel tube which is normally carried in clips behind the pilot's back. A second rudder bar, the design of which is shown in Fig. 24, is carried under the dashboard and can readily be dropped into position into a square socket partially sunk into the floor of the cockpit and connected to the pilot's rudder bar by cranks and a link.

Personnel—Seats are provided for a crew of four, who are carried as follows: one in the front cockpit; one in the pilot's seat; one at the pilot's side, and one in the rear cockpit.

All can, if necessary, change places while the machine is in the air. Between the front cockpit and that of the pilot a sliding panel is provided through which the gunner can crawl. The seat at the side of the pilot folds up and slides back into a cavity under the coaming of the nacelle and when in this position allows access down a narrow and inclined passageway to the rear cockpit. The machine can hardly have been designed to satisfy the requirements of the average pilot in regard to view, as from the pilot's seat it is very difficult to see the ground properly on account of the position of the lower main plane and the width of the body.

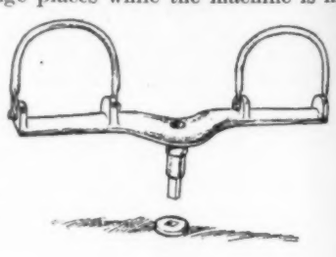


FIG. 24

Armament—Two Parabellum guns are mounted, one in the front cockpit and one in the rear, and provision is made for mounting a third or for transferring one of the others on the floor of the rear cockpit, so that it can fire backwards and under the tail of the machine. For this purpose a large trap door, which is shown in Fig. 25, is provided in the floor of the body behind the rear cockpit. This trap door has celluloid windows and is normally kept closed by springs. It is lifted

up by a small hand winch fitted with a ratchet. It is of passing interest to note that whereas in the Friedrichshafen a similar trap door was kept open by means of springs, in the A.E.G. springs are used to keep the door closed. In the front cockpit the gun is supported on a carriage which runs round a partially circular rail which is strongly supported from the body by

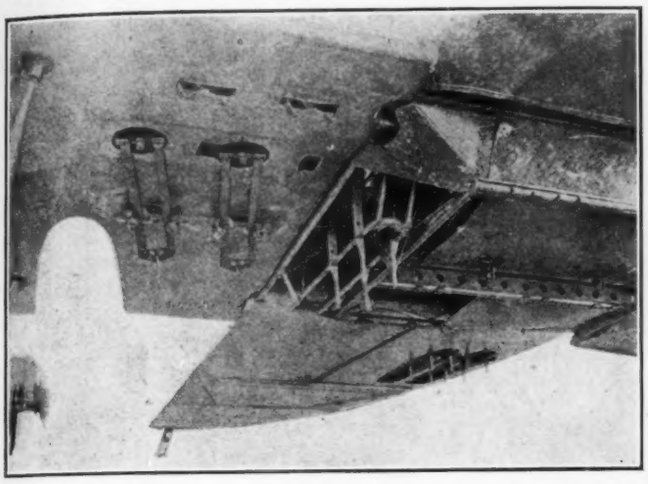


FIG. 25 UNDERSIDE OF THE NACELLE SHOWING BOMB MAGAZINE AND RACKS; ALSO TRAP DOOR IN REAR COCKPIT

a framework of steel tubes. Forming part of this frame is an inclined steel tubular column, the base of which is fitted in a swivel bearing in the floor of the cockpit, and on this is

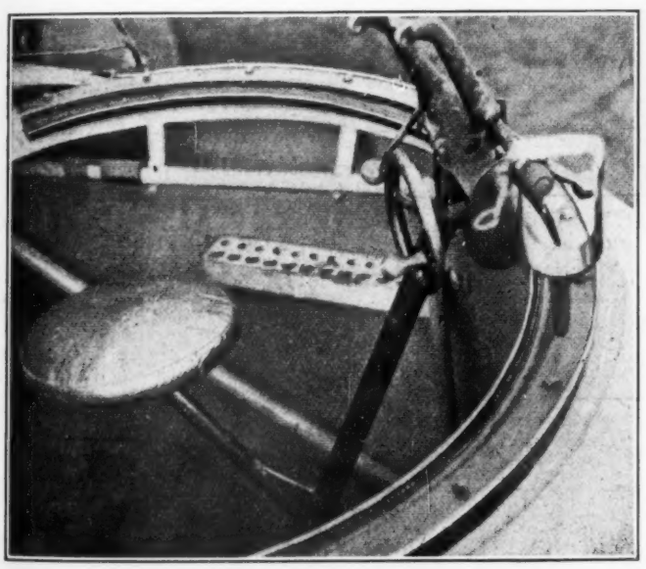


FIG. 26 FRONT COCKPIT AND GUN MOUNT

mounted an adjustable seat for the gunner. A toothed rack runs round the rail and engages with a spur pinion driven by a hand wheel so that the gunner, when occupying his seat, swivels himself round as well as the gun. This gun mounting is shown in Fig. 26, and a diagrammatic section of the carriage is given in Fig. 27. The vertical swivel of the fork-ended gun carrier is locked by a ball-ended lever and a similar lever is employed for locking the carriage itself to its rail.

This action is accomplished by a cam device which depresses the roller of the carriage and squeezes the rail section between the roller and an adjustable set screw which normally just clears the groove on the under side of the rail.

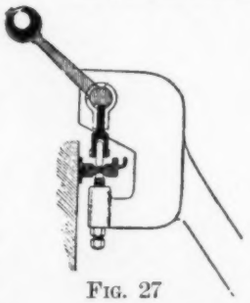


FIG. 27

In order to prevent the forward gunner from shooting the tractor screws, preventative shields of light steel tube are carried between the upper edge of the forward cockpit and the inclined struts of the center section. These impose a limit to the travel of the gun. In the rear cockpit the gun mounting is U shaped in plan form, and here again the principle of a carriage running on a rail and driven by a spur gear meshing with a toothed rack is employed, though in this case the gunner's seat does not revolve with the gun (Fig. 28). The carriage is of a somewhat similar type to that used in the front cockpit, but the method of locking it is different. This is shown diagrammatically in Fig. 29. The rail is provided with grooves both above and below, there being two rollers at the top and one

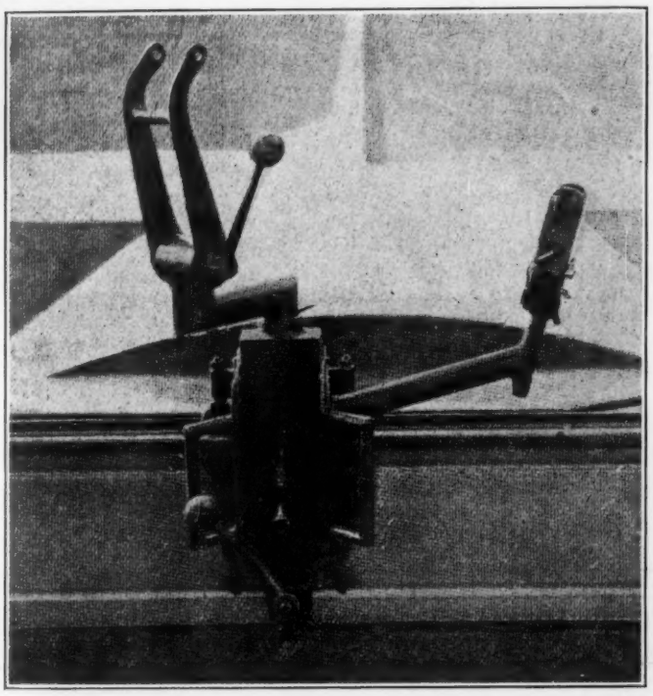


FIG. 28 GUN MOUNTING IN REAR COCKPIT

underneath. Normally, when the gun carriage is free, the latter is clear of the rail, but when the locking mechanism is brought into action it is forced upwards so that the rail is gripped between the rollers, thus avoiding any possibility of shake at this point, and at the same time a positive lock is obtained on a second rail carried below the first. When the ball-ended hand lever is tightened, its effect is to squeeze the lower rail between two jaws. The movable jaw is, however, connected up by a link to a small cam, the base of which abuts against the foot of a fork-ended rod which carries the lower roller and is free to move up and down in a guide, to the base of which the cam is pivoted. By this means a very secure and rapid locking device is obtained. In the front of the rear cockpit a locker is provided which would be capable of holding ammunition, and beneath this a series of racks of the type shown in Fig. 30. These racks are not strong enough to hold anything very heavy, and are placed approximately 5 in. apart. Their exact purpose is not known.

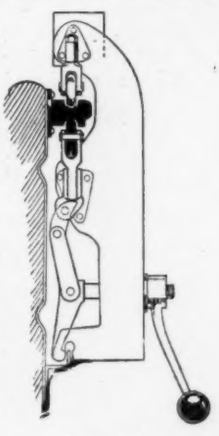


FIG. 29

Bombing Gear — Three racks for holding twenty-five pounder bombs are installed on the machine; two side by side on the left side of the rear cockpit, and one on the right side of the fuel tanks in the space between the pilot's and rear cockpits. This rack is covered by a detachable wooden lid which acts as the floor of the narrow gangway mentioned above. Underneath the center of the nacelle provision is made for carrying two or more large bomb racks, which, however, were not in

use on this machine. Underneath the lower main plane, two at each side of the nacelle, are fixed bomb clips which are capable of supporting bombs roughly 8 in. in diameter. They are held in position by a belly-band consisting of two steel strips, clearly shown in Fig. 25. Eleven and a half inches in front of this clip is a bracket suitable for a circular section of 4 in. in diameter, and 13½ in. in the rear of the clip is a second bracket suitable for a 5 in. diameter section. The bomb would thus appear to be 50 kg. In Fig. 25 the belly-bands are shown clipped out of the way. At their fixed end they are supported on a crosshead, a sketch of which is given in Fig. 31. This in turn is carried on a bracket clipped to a steel tube running parallel to the wing spars and braced thereto by tubular steel girders. The crosshead is free to swivel on the bracket against the action of a coiled spring which, when the bomb has been released, twists the crosshead round against a stop, so that the belly-band is forcibly swung round and now faces the direction of flight instead of lying edgewise on to it. The ends of the steel strips are swiveled on the crosshead, and here again coil springs are used, so that the tendency is for the belly-band to be held flat against the lower surface of the bottom main plane and out of the way of the other clip.

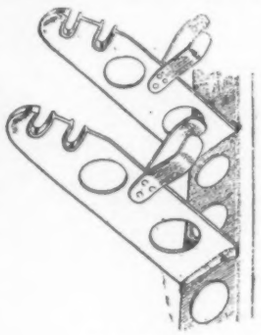


FIG. 30

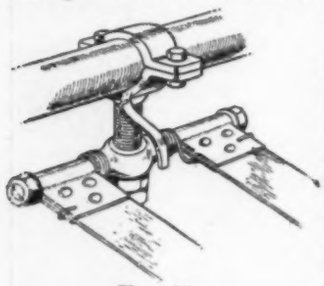


FIG. 31

When the bombs are in position the rings which are fitted on the free end of the belly-band are caught between the jaws of a trigger mechanism, illustrated diagrammatically in Fig. 32. This device is carried on the same tube which supports the crossheads, as already mentioned. Lying parallel to this tube and between it and the leading spar is a control rod fitted with two levers, which are connected respectively to the two bomb trip gears, and this rod is operated by a quadrant lever mounted in the front cockpit. In order to allow one trip gear to be worked at a time, the link of the outer trip is provided with a slot where it is pivoted to the trigger release. On working the lever in the cockpit, therefore, its first action up to half-way over the quadrant is to release the bomb nearest the nacelle, whilst a further movement releases the outer bomb. An exactly similar method is employed for operating the bombs carried underneath the other wing. The levers in the front cockpit are all mounted on a common bracket built up of steel tubes, and are arranged as follows:—First, there are the two levers which control the two bomb magazines in the rear cockpit. These are provided with thimbles and chains, so that they cannot be operated accidentally. Next, a single lever which controls the larger bomb clips on the right wing. These are capable of being secured by split pins inserted in their quadrants. Next, there is a lever which in this particular machine was furnished with no action at all, but is evidently designed for manipulating the large bomb carriers when these are installed. Behind it are, first, a single lever for the left-hand outer bomb clips, and, finally, the lever for working the bomb magazine on the right-hand side of the nacelle.

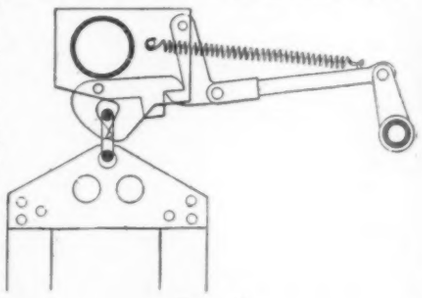


FIG. 32

Landing Gear—The landing gear of the A.E.G. Bomber is simply an elaboration of that which has become practically a standard fitting on single and two-seaters, except that in this machine the gear is in duplicate. It consists of two axles carrying two wheels apiece, and suspended from pairs of V struts. One pair is connected to the spars of the center section immediately underneath the engine strut sockets, and the other to the spars midway between this point and the body, and at the same point from which diagonal struts are taken from the spars to the engine mounting and nacelle. This, together with the wire bracing of the landing gear struts, provides a completely triangulated construction. The struts are, however, connected by ball joints similar to those used with the engine struts, so that in case of strain a certain amount of free movement can take place. The pairs of V struts carry at their foot a hollow steel crossbar having the section of a trough, and in this lies the axle which connects the two wheels. As shown in Figs. 33 and 34, the fixed beam has forward and rearward extensions, at each end of which are anchored the ends of the batteries of coil springs which act as shock absorbers, and at their other ends are hooked to a horn plate on the wheel axle. Each battery of springs, of which there are four to each axle, consists of 18 springs. A yoke of stranded steel cable restricts the movement of the axle beyond a certain limit. The tires are 32 in. × 6 in. = 810 × 150. A tail skid of massive proportions is used. This is built up entirely of welded steel. The springs against which it works are concealed inside the tail end of the body.

Wireless — The machine is internally wired for wireless, and a special dynamo for supplying current for this purpose and also for heating is installed on the right-hand engine. This dynamo bears the following inscription:

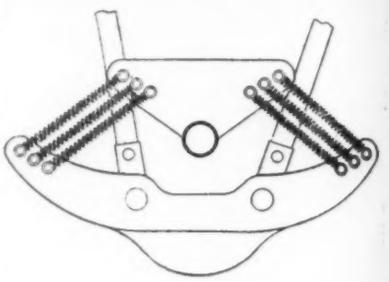


FIG. 33

Telefunken

J. P. Flieg C 1916 Type D

Alternating current	270 watts	5 ampères	600 frequency
Continuous current	50 volts	4 ampères	r.p.m. 4,500

The dynamo is mounted on brackets acetylene-welded to the steel engine bearers, and is normally completely enclosed in a detachable fairing. The dynamo drive embraces the pulley,

FIG. 34 UNDER-CARRIAGE

which is a standard fitting on the 260-hp. Mercédès, but in this particular case the clutch gear whereby the driving pulley can be disconnected from the engine as required appears to have been discarded. Two sets of wires are taken from the dynamo inside flexible metal conduits to a pair of plugs situated at the junction of the fuselage and the right-hand lower main plane. Here they terminate in plug sockets, so designed that the plugs

cannot be inserted wrongly. One of these wiring circuits applies to the heating system, and wires for this purpose are carried to points in all three cockpits, whilst the other circuit is for wireless and terminates in a plug adapter in the rear cockpit. No wireless instruments were fitted. Two plug sockets for the heating installations are arranged in the rear cockpit, two in the pilot's cockpit, and one for the forward gunner.

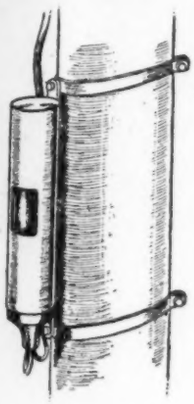


FIG. 35

In addition to these two circuits there is a lighting installation in conjunction with a battery carried in a box in the rear cockpit. From here wires are taken to each cockpit, and also to the tail and via the leading edge of the upper plane to the extreme outside strut of each wing. On these struts red and green lights are carried, the lamps for this purpose taking the form shown in Fig. 35. Inspection lights are provided at convenient points in each cockpit over the dashboard, instruments, etc.

For the most part the lighting wiring is contained inside a light celluloid conduit.

Instruments—These comprise twin engine revolution counters, twin air pressure gauges for the petrol supply, electric thermometer, altimeter, petrol level gauges, etc. All of these are of recognized types and call for no detailed description.

Camouflage—This machine is camouflaged in six different colors on a uniform system covering every portion. The colors are arranged in hexagons measuring roughly 18 in. across the flats, and the colors are sage green, reddish mauve, bluish mauve, black, blue and gray. These colors are not flat washes, but are softened by being stippled and splashed with paint of a lighter tone. The effect gained is well shown in Fig. 36. Considerable care appears to have been taken with this camouflage scheme, which is presumably effective.

Fabric and Dope—The fabric throughout is of good quality and the dope acetate of cellulose.

Propeller.—Diameter 10 ft. 3.8 in. ± .20 in.; Pitch 59.3 in.

The following table gives the thicknesses of the various laminæ used in construction of the air-screw. The laminæ are numbered from the trailing to the leading edge:

No.	Material	Thickness in inches
1	Walnut	.73
2	Mahogany	.80
3	"	.80
4	"	.80
5*	"	.80
6	"	.80
7*	"	.40
8*	"	.40
9	"	.80
10	Walnut	.83

Only one air screw has been seen and dimensioned. Thus it is unknown whether all air screws would have laminæ of similar thicknesses and of similar timbers. There is no apparent reason why these laminæ should be of different thicknesses. It is surmised that either the enemy is short of timber or that he has a highly scientific reason for so doing that we do not know. The port and starboard air screws rotate in opposite directions.

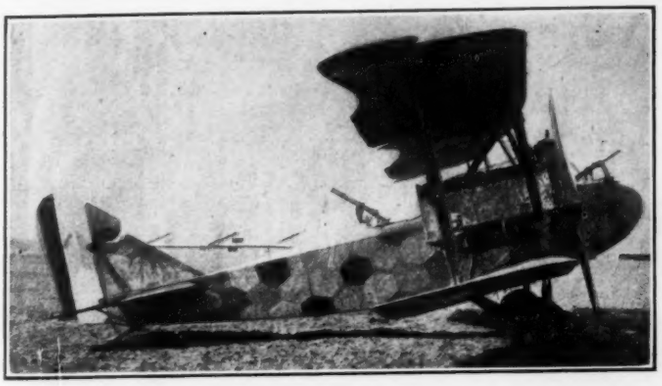


FIG. 36 A.E.G. BOMBER G. 105—SIDE VIEW

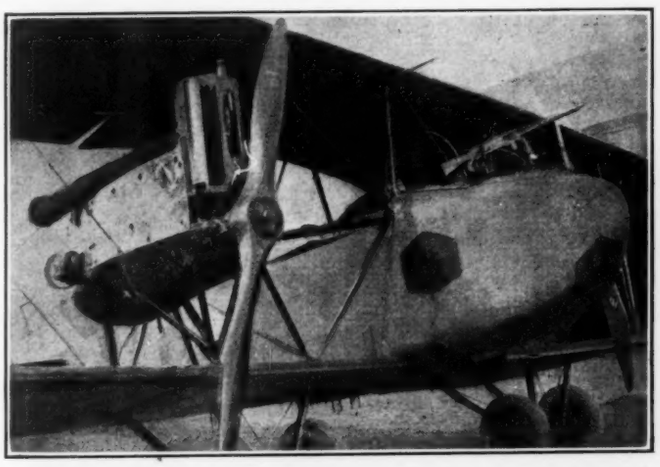


FIG. 37 THREE-QUARTER FRONT VIEW OF NACELLE AND ENGINE

* These laminations were of a quite different kind of mahogany, probably African.

The Fokker Wing Truss

Mention has more than once been made in these columns of the peculiar "wireless" or internal wing truss of the Fokker triplane. In view of the considerable curiosity this type of construction has elicited, the following detailed discussion of the Fokker wing truss, reproduced here from *Flight*, should prove of particular interest.

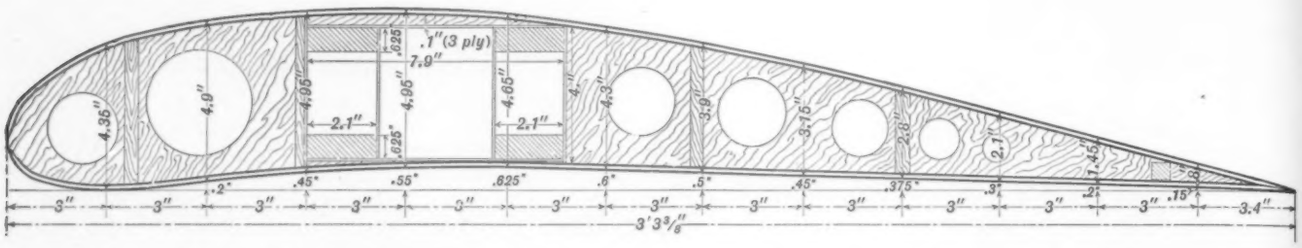
Although wing sections are nowadays probably thicker, on an average, than they were some years ago, due to the more insistent demands for strength and light weight, there are few machines, if any, that can compare in this respect with the Fokker triplane. The maximum depth, which occurs in the neighborhood of the front part of the composite spar, is no less than 4.95 in., or practically 5 in., and this for a chord of only 1 meter (about 3 ft. 3¼ in.).

The web of the rib, which is made of thin three-ply, is unusual in that it is not cut where it abuts against the spar faces, as is general practice, but is continuous from leading the trailing edge. This has been made possible by the fact that the composite spar is of a rectangular section of a maximum depth determined by the rib depth at the rear edge of the spar, which leaves a small space between the top and bottom faces of the spar and the rib flanges. Whether or not this provides any very great increase in the strength of the rib is perhaps doubtful, but keeping the spar of rectangular section would certainly appear to have advantages from the point of view of construction, as all the four strips of the spar may thus be kept of rectangular section instead of, as they would otherwise have to be, being shaped to fit the slopes of upper and lower faces of the spar.

The accompanying drawing gives the dimensions of the

various component parts of the spar. These dimensions apply to the inner portion of the spar, near the root, and to this point only, as the dimensions vary throughout the length of the spar, an attempt having apparently been made to proportion, to a certain extent, the strength of the spar to the load at any point. As regards the four spruce strips of the spar, these are tapered in plan view, their width from front to back changing from about 2 in. at the root to about ⅜ in. at the tip. The depth of the flanges, on the other hand, remains constant. The ply-wood covering or box spar has also been varied, the outer half being covered with one layer of three-ply, while the inner portion has an extra thickness of three-ply, making in reality a flange of six-ply wood.

As the wings are to be regarded as cantilevers, the object of this construction is evidently to reduce weight to a minimum by reducing the size of the spar where the loading permits of doing so, that is to say more or less gradually from the root towards the tip. From tests carried out by Naval Constructor J. C. Hunsaker, U. S. N., at the Massachusetts Institute of Technology on triplane combinations of wing sections of the R. A. F. 6 type, it appears that for a triplane combination in which the three wings are of equal span and chord and not staggered, the triplane K_y is .0004, while the value of upper, middle and lower wing K_y is respectively, .0006, .0002 and .0004. In other words, the K_y of the lower wing is practically the same as that of the triplane combination, while that of the upper wing is very much greater and that of the middle wing considerably smaller.



WING SECTION OF THE FOKKER TRIPLANE—THE WEB OF THE RIB IS MADE OF VERY THIN THREE-PLY WOOD AND THE FLANGES OF SPRUCE

In the case of the Fokker allowance should be made for stagger and for the fact that the three wings are of unequal span, but as we have no data to go on, and since, moreover, any difference in interference caused by the unequal spans will probably not be sufficiently great to seriously affect our purpose of making an *approximate* estimate of the spar stresses, we shall disregard the difference due to unequal spans and take the figures as they stand. The weight of the Fokker triplane is given as about 1,260 lb. The area of the top wing is about 83 sq. ft., that of the middle wing 54.5 sq. ft., and that of the bottom wing 51.9 sq. ft. Assuming the lift distribution to be the same as that found by Hunsaker, we obtain a lift of 9.21 lb./sq. ft. of the upper wing, 3.09 lb./sq. ft. of the middle wing, and 6.14 lb./sq. ft. of the lower wing—the average loading being that of the bottom wing, or 6.14 lb. per sq. ft.

Fundamentally the Fokker wing bracing is such that each wing may be considered a cantilever beam, and they would be truly so except for the struts, or rather ties, connecting them. These ties, however, only serve to force the middle and lower wings, which are more lightly loaded on account of the load distribution and also by reason of their shorter span, and which have the same spar section as the upper wing, to share some of the load on the top wing. If, therefore, we disregard the assistance given the top wing by the other two, and if we further assume a uniform distribution along the span of the wing instead of taking into account that the portion of a wing near the tip is always more lightly loaded than the inner part, we can hardly be accused of being unduly optimistic with regard to the Fokker wing system.

The load carried by the upper wing in the Fokker triplane is $9.21 \times 83 = 764.43$ lb., say 770 lb. The central span is about 5 ft. 2 in., leaving on each side a cantilever of about 8 ft. 4 in. or 100 in. Assuming a uniform loading along the span, and remembering that the bending moment on the center section is $\frac{wl^2}{8}$, while that on the cantilever portion is $\frac{wl^2}{2}$, it will be seen that compared with the bending moment on the cantilever, the bending moment on the center span is negligible. As a matter of fact it is only about 1400 lb. in. The loading per inch run is 2.9 lb., and the bending moment on the cantilever is

$$\frac{wl^2}{2} = \frac{2.9 \times 100^2}{2} = 14{,}500 \text{ lb. in.}$$

Since the dimensions of the four spruce flanges of the spar are 2⅛ in. by ⅝ in., the area of the four spruce sections is 5.36 sq. in. The depth of the spar is 4 in. and the section modulus Z may be taken with sufficient accuracy as being equal to area of flanges multiplied by half the depth of the spar, or $5.36 \times 2 = 10.72$. Assuming the strength of spruce as being 8500 lb. sq. in. the moment of resistance of the spar flanges will be: $8500 \times 10.72 = 91{,}120$ lb. in.

Treating the box spar formed by the ply-wood separately, the section modulus

$$Z = \frac{1}{6 \times 4}(7.88 \times 64 - 7.38 \times 52) = 5.02$$

and the moment of resistance of the ply-wood box, assuming the strength of the ply-wood to be the same as that of spruce, will be: $8500 \times 5.02 = 42{,}670$ lb. in.

The total moment of resistance of the spar will then be $91{,}120 + 42{,}670 = 133{,}790$ lb. in. Without knowing the travel of the center of pressure on the Fokker wing section it may reasonably be assumed to be such that it may coincide with one flange of the composite spar, and to be on the safe side we shall take it that when the c.p. is in this position the strength of the composite spar is reduced to half. The moment of resistance is then 66,895 lb. in., and as the maximum bending moment was found to be 14,500 lb. in., the factor of safety is apparently about 4.5. This is without regard to the fact that this load is greatly reduced by the interplane struts. One can, therefore, only arrive at the conclusion that the Fokker wing bracing system need not be inherently weak, although detailed calculations based upon more exhaustive data than we have available would possibly indicate that the spar weight compares somewhat unfavorably with that of spars of more usual type and arrangement.

As regards the aerodynamical qualities of the Fokker wing section, it is difficult to express an opinion. Generally speaking machines of the Fokker class have been found most efficient for their purpose when fitted with wings of a section giving a rather low K_y but a good L/D ratio, whereas the deeply cambered section, having a very high value of the lift coefficient, has generally a smaller L/D value. Probably the section has been chosen primarily with a view to accommodate the very deep spars, and because it has been found in practice to give reasonably good results—especially at a considerable altitude.

It would appear that the section is suited for good climb rather than for great speed, and according to German claims, the climb of the Fokker is what they like to boast of rather than the speed. Taking it all around, it is doubtful if the gain in reduction of head resistance due to absence of external lift wiring is sufficient to make up for the necessarily heavier wing construction. Of strength, it would appear from the foregoing that one can only conclude that this can be provided to an adequate degree.

Balsa Timber in Costa Rica

Balsa, the lightest wood so far known, is now much in demand where lightness of construction is of importance; and as it is very porous, it acts as a good insulator and is also used in insulation against heat and cold.

Though the Balsa tree grows best in rich ground, it will thrive on almost any ground in the Tropics except swamp, but it is a second growth tree, being found only where the ground has once been cleared. The trunks of the trees are smooth and mottled white and gray. No parasites seem to grow on them, as the boles are perfectly free of vegetation. The leaves of the young trees are very thin and large, often 12 to 14 inches across, and grow on long stems of 18 inches or more. The trees grow separately in groups of male and female, the male being known as Burrillo and the female as Balsa Real. The latter only is now marketable, as the male tree contains too much wood fiber. Both groups are very similar in appearance except at flowering time. Around Turrialba the trees of both sexes are said to contain too much wood fiber for market purposes.

Small vines are the worst enemy of young Balsa, as the young trees are soft and very sensitive. When the sapling is about 3 inches out of the ground all surrounding weeds should be cleared away. In one year the trees sometimes grow to 10 feet in height and 4 inches in diameter and to a height of 20 feet in two years. Until they reach this development the trees contain too much vegetable matter to be fit for use. A diameter of 10 inches is acquired in five or six years. A 5-year-old tree should produce at least 200 board feet, worth about $8 at current prices. Dimensions of logs for market are now 8 to 30 inches in diameter and from 8 to 16 feet long.

There is a white Balsa and a red Balsa, or Balsa Colorado, as it is called. The white, Balsa Blanca, and the red are alike in the flowering season and in general appearance; and in standing timber the difference is hardly apparent, but when cut the bark of the Balsa Colorado has a deep red tinge, from which it derives its name. It requires twice as long to dry, and even when dry it is twice as heavy as Balsa Blanca, having more sap and more wood fiber. Some of the logs have a dark, reddish core, which contains enough sap or moisture to cause decomposition and render them worthless. Logs cut from the lower part of the tree next the root contain a great deal more water than the upper part, but when thoroughly dry are almost as light and should be just as useful as the rest. When the white wood, or Balsa Blanca, ages it reddens, coloring from the bottom upward, and at the same time the bark roughens. Trees 8 or 10 years old are often too heavy for market. Balsa logs deteriorate very quickly after felling if exposed to the weather, and borers attack them if they become dry. The logs cannot be cut more than a week or 10 days in advance of shipping.

The United Fruit Co., shipping Balsa from Costa Rica, gives the following specifications for logs to be marketed: Minimum length 8 feet, maximum 16 feet, preferably logs not running over 20 inches in diameter, but none more than 30; bark to remain on logs; logs to be free of knots and neatly trimmed, but not pointed; to be cut only on notice; payment made in gold per thousand feet; logs to be delivered at a point where they can be conveniently loaded on flat cars. The logs are put into the ship's bunkers, not more than 400 logs to a ship.

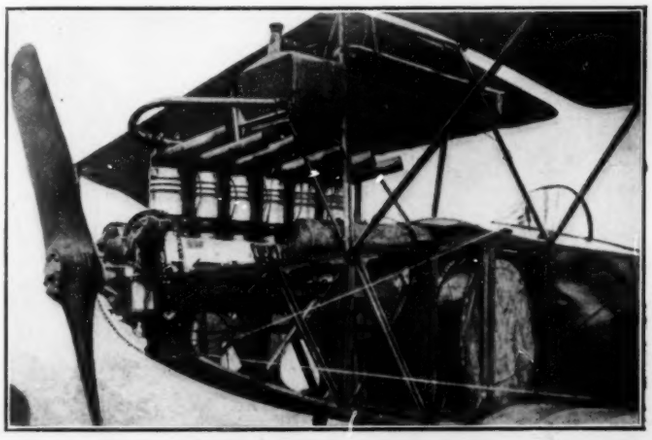
It is very difficult and sometimes impossible to get some of the timber to the tracks where it can be loaded. So long as there is a supply to be had along the railway the question of transportation is a simple one and the business lucrative, but where the logs have to be dragged for long distances by oxen the margin of profit decreases and close figuring becomes necessary. At present the average cost of Balsa delivered to the United Fruit Co. steamers is $37.50 to $40 per thousand board feet. The average content per log is 50 to 60 feet. If not too far back from the railroads, 12 yoke of oxen can get out about 200 logs per week at an average distance of 2 miles. Shorter logs at a cheaper rate per thousand feet than the regular size logs cannot be shipped for the reason that the work of handling is increased; that is, three 16-foot logs can be dragged out to the tracks at about the same cost as three 4-foot logs; the same estimate applies to handling logs from wharf to ship.

In all there are probably not more than 8,000 Balsa logs available to the railroad in Costa Rica at this time; but if the United Fruit Co.'s practice of shipping only about 400 logs per week is followed, shipments could be continued indefinitely. In certain sections inaccessible to the railroads of Costa Rica there is much of this wood, but being so situated, and the rivers being mostly mountain streams, rocky, rapid, and shallow, the question of getting out the logs is a difficult one. There is one available big lot of timber along the San Carlos and Sarapiqui Rivers, on old abandoned farms in that section, that could be contracted for delivery alongside the steamers in shipload lots of 500,000 feet or more. The timber from these rivers could be floated down the San Juan to Colorado Bar, above Limon, where it is possible in favorable weather to cross without much risk, providing suitable equipment were at hand in the form of barges for loading the logs, and sufficient towing power. The timber would have to be loaded on barges in the fresh-water lagoons and then towed to sea for transfer to the ship, or from the bar direct to Limon for reshipment at this point. Salt water, however, is said to have certain deteriorating effects on the wood.

The future of the Balsa trade in Costa Rica depends very largely on whether or not it can be successfully grown by plantings on land prepared for the purpose. There are indications that it can be. The United Fruit Co. in Costa Rica has 200 acres planted on what is known as "Guacimo Farm," and this timber, which is about two years old, appears to be doing well. This planting was done 12 by 12 inches apart, and if later this is found to be too thick the weaker plants will be pulled up. While the rainfall is sufficient for planting thus thickly it takes considerably longer for the tree to reach marketable size, but when mature it is much taller and freer of branches, besides yielding a larger number of logs. It will take about eight years for trees planted in this order to reach marketable size and they will then yield logs about 12 by 14 inches in diameter and 28 to 30 feet long. The Guacimo tract should therefore produce 100 trees per acre with 200 board feet of good log, or 20,000 board feet per acre.

The cost of straight planting, including cleaning and preparing the land, lining, circling, and planting (using small plants set out to a stake), and three windrowings to complete cultivation for first year, should not cost more than $10 per acre, as follows: Cleaning and preparing land, $3; circling, lining, and planting, $2; circling and windrowing, $3; 10 per cent supplying at $0.01, $0.10; overhead and miscellaneous, $1.90.

After a period of 14 months from time of planting no expenses for cultivating are entailed. Another and a cheaper method of planting Balsa is to clean and burn the land and scatter seeds where necessary. The work can best be done from January to March; during the remainder of the year it is difficult to burn owing to the constant rains. By this method a grove should be established for a maximum expenditure of $4 per acre. After a year no further work is required.—*U. S. Consular Report.*



THE MOUNTING OF A BENZ ENGINE IN AN L.V.G. BIPLANE

(C) *Kyprie Photo Service*

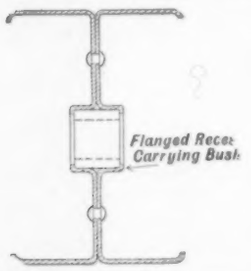
Novel Ideas in Airplane Construction

There is a very general impression that the airplane represents in its present-day outlay and construction a definite product, comparable in this respect to the modern motor car. This belief is more or less based on the not wholly unwarranted assumption that there seems to be little likelihood of the aerofoil, the aero-engine, and the airscrew being made more efficient to any considerable extent.

As a matter of fact, improvements in the above items are being achieved day after day, but the rate of progress is exceedingly low, and it really seems as if quite some time were likely to elapse before the average aerofoil will lift more than 10 lb. per sq. ft., or the massic power of aero-engines will be reduced below 2 lb. per hp. Parasite resistance, on the other hand, has already been reduced by careful streamlining to such a small percentage of the total resistance that apparently little remains to be sought in this line.

Real progress, that is, increased aerodynamical efficiency, would then seem to depend on a reduction of weight per horsepower, either by the use of lighter materials—provided they be consistent with the required strength—or novel methods of construction.

An interesting suggestion is made in this respect by F. W. Halliwell, A.M.J.I.E., in *Flight*, to the effect of making the elimination of wood, canvas, and to a lesser extent wire bracing, the keynote of an improved method of airplane construction. The weight of the bracing wires and turnbuckles used in the construction of present-day airplanes is considerable, and recent designs, particularly German, show a marked tendency to eliminate these, at least in the body, by substituting three-ply bracing, thus dispensing with the fabric covering, or else employing the monocoque (veneered single-shell) type of body, which was originated by Deperdussin.



DETAIL OF CONSTRUCTION

The author contends that an all-metal construction, preferably of duralumin, would seem to possess many advantages over the existing types, in addition to being non-inflammable. Duralumin is suggested because this metal most nearly approaches the standard of strength for weight required, though it may not necessarily be regarded as an absolutely suitable material.

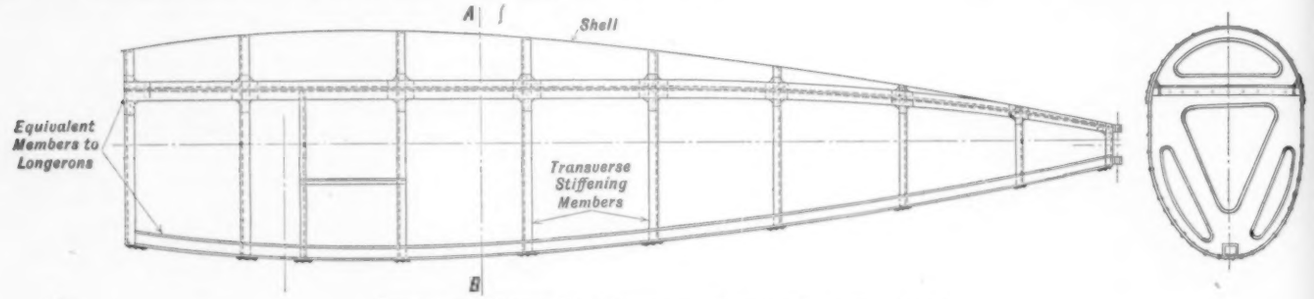
Proceeding along these lines a new method of body construction is shown in the accompanying drawings. In this system there are retained equivalent members to the longerons, but in all probability these need not be more than three in number, and would be of channel or T-section, built up as indicated, and running the whole length of the body. At intervals there would occur transverse stiffening members lightened out and flanged at all edges; these are riveted to the shell and connected also to the longitudinal girders. The shell itself would be made in sections, and of varying gage metal, so that the stresses would be proportionate along its length, while inspection doors could easily be provided whenever necessary.

What is now, on existing machines, a separate cowling, or fairing, extending from the rear seat down to the tail, would in this construction be an integral part of the whole body.

In machines where a long engine is used, the front end of the body could be strengthened up in order to relieve the shell itself of all stresses in these sections, so that it could be made completely detachable, for the sake of accessibility.

The flange transverse members employed in this construction lend themselves more readily to any scheme for carrying controls, supporting fuel tanks, seats, etc., than does the average cross sectional wire bracing.

A similar system to the foregoing would be applicable to the wings. In this case the main spare would be of T or channel section, preferably a T section, built up of two channel members back to back, riveted together, and provided at intervals with collars let into flanged recesses, which would serve the twofold purpose of registering the members prior to drilling, and relieving the rivets of sheer stresses when in flight.



SIDE AND FRONT ELEVATION OF PROPOSED STEEL BODY

For bracing against drift the existing system of struts and wires could be employed, in which case the compression members would be of light gage tubing, and the "formers" a simple flanged arrangement.

The leading edge could be of suitable section duralumin, and for the trailing edge oval tubing, such as is now used, would suffice.

In considering the wing covering, it becomes apparent that there are several difficulties to be overcome. The satisfactory attachment of the sheet metal is one. It is comparatively easy to cover the top, or the underside, by riveting to the "formers" and spars, but it is not easy to get at the rivet heads on the inside when both the top and bottom of the wing are covered. This might possibly be overcome by covering in sections or providing sufficient inspection doors.

In view of the fact that this construction is, for the same strength, lighter than the orthodox one, some of the advantages possessed by it will be of interest.

First and foremost is that of non-inflammability. The danger of fire is at the present day the most serious risk the average pilot takes, so that if this can be achieved, even at the expense of something less important, it is a step in the right direction. It naturally follows also that this system is impervious to most other elements, and will outlast any number of machines built of less durable material.

The absence of bracing wires is obviously desirable. Existing machines to be kept in trim demand periodical adjustment, which is not a five-minute job; also oil and gasoline will not deteriorate the shell as they do doped canvas. From the design point of view, more accurate workmanship is possible than with the materials at present employed, while there is less uncertainty about the ultimate strength.

Finally, the construction lends itself more readily to a well streamlined shape, and, though obviously not suitable for making in ones and twos, is eminently adapted for quantity production, because of the number of parts which could be pressed out cold and would be interchangeable.

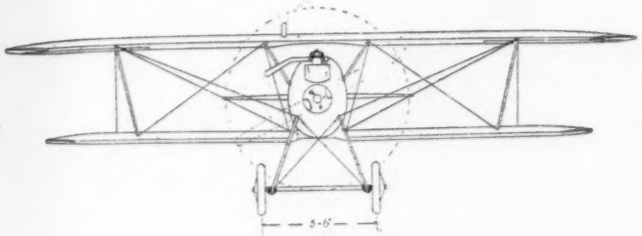
Bibliography of Aeronautics

An appropriation of $10,300 requested by the National Advisory Committee for aeronautics for the purpose of printing and binding the "Bibliography of Aeronautics" is included in the $200,000 allotted to the committee according to an amendment to the Sundry Civil Appropriation Bill adopted by the Senate on June 24. Dr. Wolcott states that the book, which has been prepared in typewritten form, is a continuation of the last publication from July, 1909, up to Jan. 1, 1917, and consists of 38,000 titles.

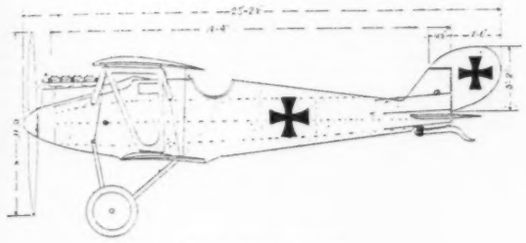
Digest of the Foreign Aeronautical Press

Flying (London), May 22, 1918

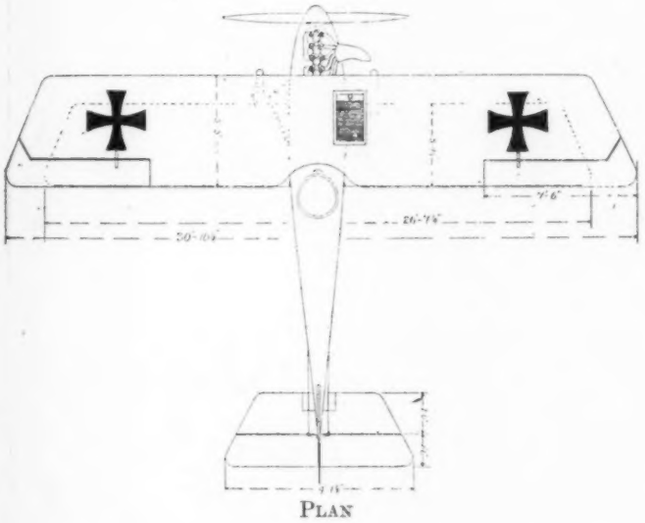
The Pfalz Pursuit Biplane.—In comparison with the average German airplane the Pfalz is of light construction generally and incorporates some interesting constructional details.*



FRONT ELEVATION



SIDE ELEVATION



PLAN

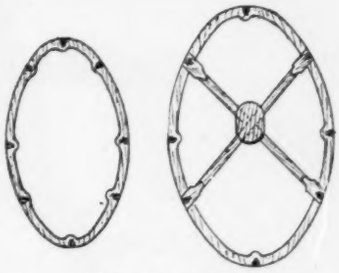
The top plane has a span of 30 ft. 10½ in. It is rectilinear in front elevation, being of the one-piece type. The radiator is let into the plane on the right-hand side, and conforms to the wing curve, while on the left-hand side a gravity gasoline tank is housed. This portion of the plane is strengthened with a covering of veneer. The thickness of the wing section decreases toward the tips, and the incidence is also slightly washed out.

The lower plane has a span of 26 ft. 7¼ in., and is made up of two panels of 12 ft. span which are attached to short wing roots built integrally with the body. The incidence of both wings is 4½ deg., that of the lower plane being, however, washed out to 2½ deg. The wings have a positive stagger of 1 ft. 4½ in.

The chord of the upper plane is 5 ft. 5 in., that of the lower plane, 3 ft. 11½ in. The gap, at the body, is 4 ft. 7 in.; the overall length, 23 ft. 2½ in.

Balanced ailerons are carried on the top plane only, and are operated by crank levers working in suitable slots. The control cables are taken from the control lever through fiber tubes in the lower plane to a point below the aileron cranks.

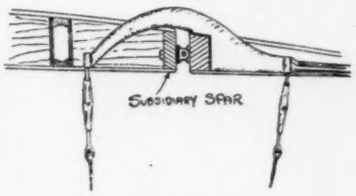
The upper plane is attached to the body by means of two inverted U-pieces which, as well as the interplane V-struts, are built up of laminated members of veneer. Ball-and-socket joints are used for all connections of these pieces. The base of the interplane struts is not attached directly to the wing spars, but to a steel tube compression member connecting the spars.



BODY FORMERS

The wing section has a deep camber to its under-face, the maximum for the upper plane being 1.9 in. This is situated about 1 ft. 9 in. from the leading edge. The lower plane is much thinner, the maximum camber to the under-face being 1.4 in., about 1 ft. 6 in. from the leading edge.

The tail plane is an inverted aerofoil, tending thereby to impart to the machine a measure of inherent longitudinal stability, and is fixed to a small center section, 10¼ in. by 1 ft. 7½ in., built in the body. There is no external bracing to the tail.



AILERON CRANK

The body is of monocoque construction, being built up on small stringers and formers, to which structure two thicknesses of three-ply strips about 3¼ in. wide are applied by diagonal crossing. The total thickness of the six layers of wood and the external fabric covering is only 1½ mm. The three-ply bands do not run completely round the body, but are joined to an upper and lower longeron, which leads to the belief that the shell is built in two halves.

The undercarriage is of steel streamline tubing, the section being about 48 mm. by 31 mm.

The engine is a 175 hp. Mercedes, which drives an air screw of 8 ft. 11 in. diameter. Two synchronized machine guns, controlled by Bowden cables, are fitted on either side of the engine.

The Aeroplane, June 12, 1918

German Giant Airplane.—The correspondent of the Havas Agency on the French front reports that the giant German airplane which was brought down on June 1 in the neighborhood of Retz (southwest of Soissons) carried nine passengers, including the pilot officer commanding, two observer officers and machine gunners, two specialist engineers, a second pilot in charge of the engines, and two other specialist engineers.

The machine is of the most recent type of giant airplanes. Its principal characteristics are as follows: Four engines, each of 300 h.p.; spread of wings, 43 meters (about 141 ft.); total length, 28 meters (about 92 ft.); crew, nine men; weight, when empty, 9200 kg. (over nine tons); weight in flight, when fully loaded, 14,600 kg. (14½ tons); weight of bombs that can be carried, about 2000 kg. (about two tons); maximum speed, 120 to 130 km. (75 to 80 miles) per hour; armament, four machine guns.

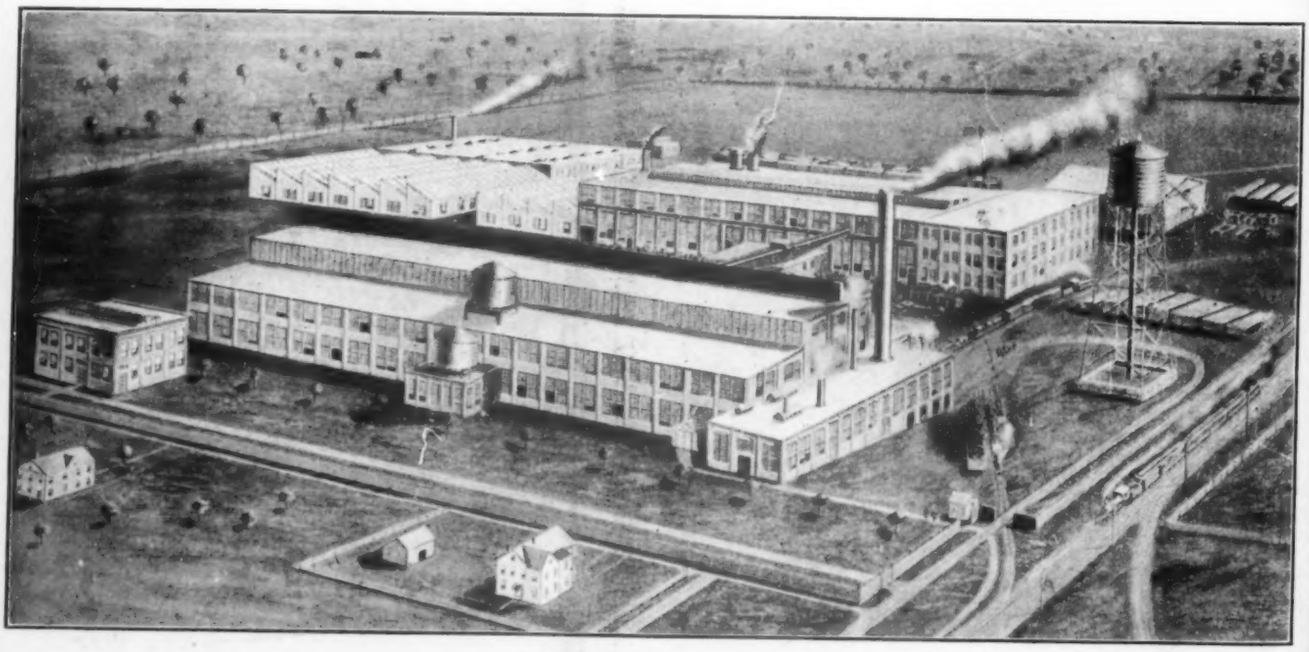
The Aeroplane, June 5, 1918

Airplane Timber in Great Britain.—Professor Groom, reading a paper in the hall of the Society of Arts on May 15, said the fact that though England had timber eminently suited for use in airplane building, the British authorities were not aware of it at the beginning of the war, while Germany knew of it, and instantly made use of it. Last year tests showed that in the south of England and the Highlands of Scotland the Scotch pine could yield slowly-grown timber equal to the highest demands ever made on wood, namely, use in vital parts of

* A general description of this machine appeared in the June 1, 1918, issue of AVIATION AND AERONAUTICAL ENGINEERING.

Lawson AIRCRAFT

THE PRODUCT



THE PLANT

From Green Bay Press-Gazette

May 2nd, 1918

NEW MACHINE OF LAWSON COMPANY MAKES FLIGHTS

Six Trials Made and Members of Company Taken as Passengers.

CRAFT HANGS HIGH IN AIR 15 MINUTES

Hovers Stationary at Altitude of 5,600 Feet; Many People See Flights.

The latest airplane to be turned out at the Lawson Aircraft shops in Green Bay was tried out from the testing field in the southwest end of the city this morning with six separate flights, lasting altogether two hours, and wholly successful.

The tests were made by Alfred W. Lawson and George Pufflea, said to be United States army flying instructor.

Mr. Pufflea, it is said has been a flying instructor for the United States government ever since the war started, and prior to that time he was a pilot for the Mexican government with the title of captain in the Mexican army.

At 5:30 o'clock this morning Mr. Pufflea took the machine up for the first time and when he landed said the machine flew perfectly.

Mr. Pufflea made two fifteen minute flights and then Mr. Lawson took the machine himself for a trip over Green Bay and De Pere, as well as the surrounding country. Mr. Lawson was up in the air thirty-three minutes and at one time he kept the machine poised in a stationary position over the heart of Green Bay for fifteen minutes at a stretch and at an altitude of 5600 feet.

From the ground the machine appeared to just hang motionlesss in the sky.

Pufflea Takes Machine.

After Mr. Lawson's flight, Mr. Pufflea then took the machine again and took up for ten minute flights, John Carisi, George Ellis and William Hoberg, all of the Lawson company. They expressed great enthusiasm and admiration for the machine upon the conclusion of their trips and it was their first experience in the air. The flight attracted wide attention throughout the city.

Mr. Pufflea said: "It is the most wonderful machine I have ever flown In fact the machine flies itself, the aviator merely thinks and the machine responds. The army people are going to get the surprise of their lives when they get this new machine. It has everything that is needed for the most up-to-date work as far as advanced training and reconnaissance is concerned. I wish there were 5,000 of them ready for the government now. There are fifty or more new features of details in the Lawson airplane than I have ever seen in any other plane before, but of course those details are secret and I cannot say anything about them."

Unusual Tribute.

An unusual tribute was paid to the memory of Wm. Kirkhoff, former employe of the Lawson Aircraft Corporation, when Mr. Lawson flew over his grave in an airplane and dropped flowers to the ground, as a token of his esteem for the dead man. The funeral took place this morning at Allouez cemetery.

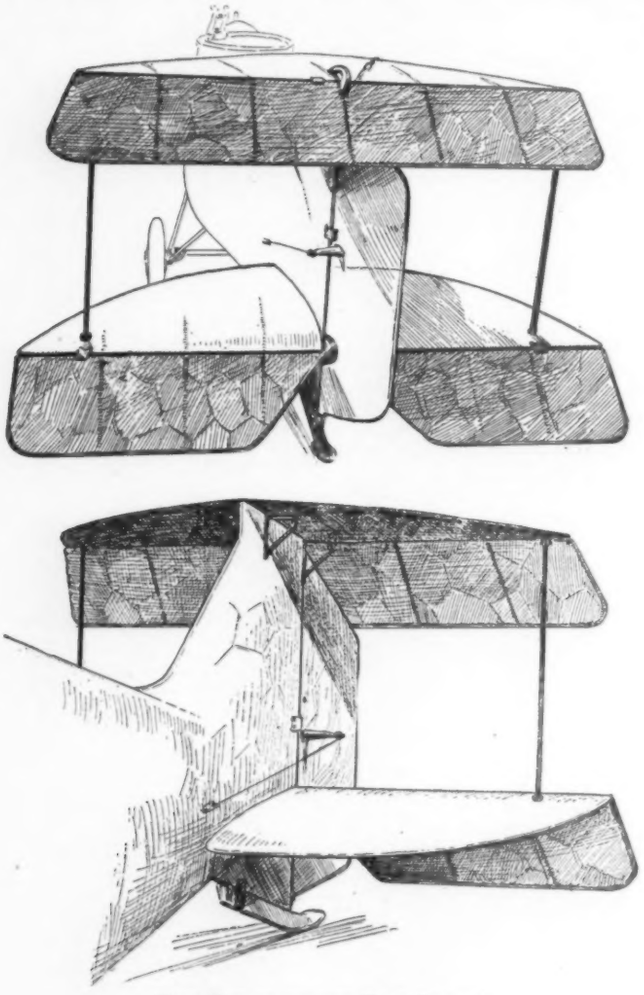
THE PERFORMANCE

LAWSON,
GREEN BAY, WIS.

airplanes. Germany, having made thousands of tests in the structure of Scotch pine growing in various of her forests, was able instantly to secure rich supplies of wood of exactly the quality required for airplanes. Dealing with the fireproofing of woods, the speaker said investigations had rendered it possible to such an extent that thin 3-ply wood could be made to resist for minutes, or even hours, a temperature of 3000 deg. F. The process of fireproofing was not, however, cheap.

Flight, May 30, 1918

*Constructional Details of the Hannover Biplane.**—Constructionally the body of the Hannover biplane is that now so frequently found on German machines, a light framework covered with three-ply. In section, however, the body is somewhat



TWO VIEWS OF THE TAIL PLANES

unusual, in that at the point of maximum depth it has flat sides and bottom, with a curved deck, while near the nose the section is nearly circular and the tail portion is oval in section, not unlike the tail of a fish. This seems rather the reverse of usual practice.

In the gunner's cockpit there is the usual hinged seat which can be swung back out of the way when the gunner wishes to fire from a standing position. On the port wall of the body there is a wood drum around which the aerial is wound, passing through a wide tube fitting in holes in the bottom of the body. Centrally placed, in front of the gunner's feet, is a framework of steel, which appears to have been used for releasing the bombs, under which there is a sliding trap door in the floor, which reveals, when removed, another compartment underneath the floor boards, which is also fitted with sliding trap door. The latter is operated by a rather clumsy arrangement of cables and pulleys; when both doors are open the way is clear for the bombs to drop. The bombs were apparently carried in racks on the floor to the right of the release gear, while on the left a number of fittings appear to indicate that here was at one time mounted the wireless set. On the starboard wall of the body is a lever which has probably been used for throwing the wireless into and out of gear. No gun was mounted on the machine examined, but the gun ring and pivot were of the usual type.

The motive power was furnished by an Argus engine partly covered in, each three cylinders of which had a common exhaust collector projecting out past the struts of the starboard "N" carrying the top plane center section.

As regards the biplane tail planes, the arrangement of these will be easily grasped from the accompanying illustrations. In design they do not appear to present anything very unusual, and the only point of interest appears to be that although the two fixed planes are connected by struts there is no wire bracing. Each plane is thereby to be considered a simple cantilever, and as their section does not appear to be very deep, the strength would not appear to be all that it might.

* See also last issue of AVIATION AND AERONAUTICAL ENGINEERING.

Flying (London), June 12, 1918

The Pfalz Pursuit Biplane.—Following official tests made by the British authorities, the Pfalz pursuit biplane is credited with the following performances, which are by the way generally inferior to those of the Albatros D-III.:

Speed at 10,000 ft., 102½ m.p.h.; 1400 revs.
Speed at 15,000 ft., 91½ m.p.h.; 1325 revs.
Climb to 10,000 ft., 17 mins., 30 secs.
15,000 ft., 41 mins., 20 secs.
Estimated absolute ceiling, 17,000 ft.
Total weight of machine fully loaded, 2056 lbs.
Weight of machine bare, with water, 1580 lbs.
Military load { Pilot, 180 lbs.
Two Spandau guns, 70 lbs.
Dead weight, 31 lbs.
Gasoline, 21½ gal.
Oil, 4 gal.
Area of main planes, 240 sq. ft.
Weight per sq. ft., 8.56 lbs.
Weight per h.p., 12.84 lbs.

The Aeronautical Journal, April, 1913

Computation of Aerodynamic Support. By W. R. D. Shaw.—The function of an aerofoil of circular arc camber is to impart motion in a circular path to a mass of air whose volume is determined by the product of span, chord, and mean sweep, the latter being a linear measure of the depth of the strata of air affected above and below the surface.

Notations employed:

Total pressure on aerofoil, lbs. wt.	P
Flight velocity, ft. per sec.	V
Chord dimension, ft.	y
Maximum camber, ft.	c
Radius of curvature, ft.	r
Span, ft.	m
Mean sweep, ft.	d
Density of air, lb. per cu. ft.	p
Acceleration due to gravity, ft. per sec. per sec.	g

By the Theorem of Pythagoras

$$r = \frac{y^2 + 4c^2}{8c} \quad \ldots\ldots (1)$$

In practice the sweep factor or mean sweep varies from 0.8 to 1.2 times the chord dimension. Taking the average value

$$d = y \quad \ldots\ldots (2)$$

The volume of air continually in dynamic contact with the aerofoil is in cubic feet from (2)

$$my^2 \quad \ldots\ldots (3)$$

The weight of the volume of air (3) in pounds is

$$pmy^2 \quad \ldots\ldots (4)$$

Taking p as .08 lb. per cu. ft. and g as 32.2 ft. per sec. per sec., the total air pressure, which in effect is the centrifugal reaction of the air on the curvilinear surface, is given by the expression

$$P = \frac{.0194\, my^2V^2c}{y^2 + 4c^2} \quad \ldots\ldots (5)$$

Aeronautical Patents

ISSUED JUNE 4, 1918

1,268,333—To Frithrof Gustof Ericson, Toronto, Ont., Canada. Landing-gear construction of airplanes.
1,268,494—To August C. Rutzen, Cleveland, Ohio. Airship.
1,268,710—To James T. Gregory, Washington, D. C. Airplane safety device.
1,268,779—To Charles L. Hudler, St. Louis, Mo. Hydroaeroplane.

News of the Fortnight

Senate Approves Aircraft Corporation

The creation of a $100,000,000 aircraft production corporation was approved by the Senate June 28. The action was taken without debate. There was not a dissenting vote. As adopted by the Senate the Director of Aircraft Production is empowered in his discretion to form the aircraft production corporation with a capital of $100,000,000. The director must subscribe and vote not less than a majority of the stock. The corporation must be dissolved within one year following a treaty of peace with the Imperial German Government. The Secretary of War is given authority to assign all men needed for making the corporation operative.

The power conferred on the Director of Aircraft Production gives him the right to "form one or more corporations for the purchase, production, manufacture and sale of aircraft, aircraft equipment or materials therefor, and to build, own and operate railroads in connection therewith."

The Aircraft Production Corporation closely follows the lines of legislation creating the Emergency Fleet Corporation, the War Finance Corporation and other organizations under which the Government is handling certain lines of industry connected with efficient prosecution of the war.

Air Service—The New Name

Official documents coming through the War Department during the past week have indicated that a new name for the new air organization has been adopted by the General Staff.

At present the plan is to make "Air Service" the official title of a branch of the National Army, and to commission officers, enlist men and civilians therein, attaching them to either the Department of Military Aeronautics, or the Division of Aircraft Production, which were created by the Presidential order separating the service from the Signal Corps, according to their respective requirements.

The plan also embraces the detail to the Air Service of officers already commissioned in the Aviation Section of the Signal Corps, Signal Reserve Corps, and Signal Officers' Reserve Corps, yet leaving enough men in the Aviation Section in the Signal Corps in order to keep it intact as an organization.

Trial Flight of American Caproni

The trial flight of the first American-built multi-engined bombing airplane, a Caproni biplane fitted with Liberty engines, successfully took place on Independence Day.

The machine was built in the Elizabeth plant of the Standard Aircraft Corp., which concern may be justly proud of the unqualified success that attended the first taking the air of the first American-built airplane of capital size.

The trial flight of the three-engined Caproni biplane took place at Hazelhurst Field in the presence of John D. Ryan, Director of the Aircraft Production Bureau; W. C. Potter, a member of the Aircraft Board, and a number of American and Allied aviators. The flight was successful in every way.

The machine was in charge of Lieut. Gianfelice Gino, a pupil of the late Captain Resnati, and carried three Italian officers as passengers. For fully an hour the big machine maneuvered above the group of watchers, and then Lieutenant Gino glided down to a perfect landing.

Screw Thread Commission

The conference committee of the Senate and House reached an agreement on July 2 on the House Bill 10,852, providing for the appointment of a commission to standardize screw threads. The bill was amended limiting the life of the commission to six months and passed.

New Company to Operate Air Lines

The Swift Aircraft Manufacturing Co., of Camden, N. J., has been incorporated, and will operate aerial lines between Chicago, Boston, Philadelphia, Washington, New York and other cities, according to papers filed with Secretary of State Martin. The papers stipulate that the airplanes, which are to be manufactured by the concern will carry mail and merchandise and will be built at plants to be erected in various parts of the country.

Aerial Independence Day Parade

The celebration of Independence Day was rendered memorable for New Yorkers by an aerial parade consisting of a large formation of airplanes and a naval airship which flew over the city during the ground parade, scattering thousands of copies of the "Star Spangled Banner."

Among the machines which participated in this aerial parade were 6 American combat machines, 21 training planes, a Caproni bomber, and a Spad pursuit plane.

Mailplane Postage Is Decreased

An anticipated announcement of a reduction in the rate of mailplane postage was made by the Post Office Department on June 29. The new rates will be 16 cents for the first ounce and 6 cents for each additional ounce or fraction of an ounce. This is a decrease of 8 cents for the first ounce and of 18 cents for the second ounce from the initial rate of 24 cents per ounce, or fraction regardless of weight.

Its purpose is to increase the patronage of the aerial mail service. If it succeeds both the Government and the public will be the gainers—the amount of mail carried per trip would be boosted nearer to airplane capacity without increasing the cost of transportation and the average revenue to the Department on a letter weighing 2 oz. would be only 2 cents less than that under the present 1-oz. rate, while the decreased cost to the public for a 2-oz. letter would be 24 cents. In other words, a 2-oz. letter under the new rates may be mailed at the price of a 1-oz. letter under current rates. The new rate becomes effective beginning July 15.

Skilled Workmen May Be Furloughed

The determination of the Director of Aircraft Production to see that airplanes are built in quantity is indicated in a set of papers sent to all aircraft manufacturers in the United States.

It is announced that the Government intends to assist contractors in meeting their labor problems. By filling out prescribed forms the Director of Aircraft Production says that indefinite furloughs can probably be obtained for any skilled or technical employes heretofore drafted.

After the draft or enlistment of any skilled employe the manufacturer or contractor may fill out certain fixed forms, and, after the man reports to the camp or recruit depot to which he has been assigned, he may be granted an indefinite furlough without pay or allowances and ordered to report to his former employer. This furlough will continue as long as the man retains his employment. He may wear the uniform or wear civilian clothing, as he chooses.

Blanks may be obtained from the Director of Aircraft Production, Washington, D. C.

N. A. C. for Aeronautics Moves

The National Advisory Committee for Aeronautics announces the removal of its headquarters from the Munsey building, Washington, D. C., to the Aircraft Administration building, Missouri avenue between Fourth and Sixth streets, Northwest, known as building "D." Its offices will be located on the second floor of the fourth wing in rooms adjoining the Aircraft Board.

All parties concerned in addressing mail or other matter to the committee are requested to use the following form:

National Advisory Committee for Aeronautics, Building "D," fourth wing, second floor, Fourth and Missouri avenue, N. W., Washington, D. C.

Airplane Walnut Supply

As a result of the President's call made upon the Boy Scouts of America three or four weeks ago to make a systematic search for black walnut for use in manufacturing airplane propellers, etc., it is stated they have met with such success that millions of feet have been located, or enough to meet the needs of the Government for months to come.

Admiral Sims on the Liberty Engine

The Secretary of the Navy has authorized the following statement on July 2:

"Secretary Daniels today received a dispatch from Vice Admiral Sims stating that the recent tests of a seaplane equipped with the Liberty engine resulted in better performance as regards climbing and load-carrying than similar airplanes equipped with one of the best types of European engines. Admiral Sims says: 'The British expressed great confidence in the Liberty motor.'"

Curtiss Square Deal Department

The Curtiss Aeroplane & Motor Corp. has taken a long stride forward in the development of industrial morale by the establishment of a Square Deal department in the Division of Education and Welfare.

The Square Deal department is for the benefit of all Curtiss employes, whether in factory or office. Its purpose is to apply the square deal to all employes and to the company itself, by removing the causes of any dissatisfaction that may arise and by placing employes in the positions for which they are best fitted.

Any employe who feels that he or she has been unjustly dismissed, overlooked in promotions, assigned to duties for which they are not best fitted, neglected in wage advances or made the victim, real or imagined, of favoritism by foreman or superintendent may bring complaint to the Square Deal department. An investigation is made immediately.

Rebreathing Machine for Aviators

By a "rebreathing machine," the first of its kind to be established by the United States Government or any of its Allies, American aviators henceforth will be classified according to their ability to thrive in high altitudes.

The machine is in a research laboratory at Barron Field and is in charge of Lieut. G. H. Hanson, W. W. Thomas and James Blair, who arrived in Fort Worth recently from Mineola, N. Y. It produces all the sensations of ascending and descending and has been in use by the German air service, it is said, for five years.

Henceforth no pilot from any of the Army fields will be assigned to active duty overseas until he has passed the tests of the contrivance and been classified according to his ability to withstand altitude fatigue. Experience has taught that many air casualties are due to this fatigue. One man will be so affected that he will faint. Another will go along with his flying mechanically and with his mind so dulled that he cannot plan or execute an attack on an enemy. Still another will become stupid and his nerves will not react to the excitement of battle.

The pilots will be divided into three classes. In the first class will be placed airmen who are never affected by altitude fatigue and who can ascend and fight anywhere their planes will mount.

In the next class will be those whose mental faculties are dulled by high altitude.

And in the last, or third, will be those who faint under the stress.

Doehler to Build Addition

Ground has been broken for the new addition to the Doehler Die-Casting Co.'s Brooklyn factory on Court and Huntington streets. This addition will cover 150 ft. on Court street and 200 ft. on Huntington street, and will be ten stories high, actually doubling the present capacity of the plant.

Construction will be of steel and concrete throughout, to conform to the general character of their present structures.

Newly perfected types of automatic die-casting machinery are now in process of construction, ready to be installed in the new building, which is to be ready for occupancy before the summer is over

Contract for F5 Surfaces

Curtiss Aeroplane Motors, Ltd., Toronto, Canada, has been awarded a contract for F5 surfaces by the Bureau of Supplies and Accounts of the Navy.

Statement on Aircraft Production

At the suggestion of Representative S. Hubert Dent, Jr., chairman of the House Committee on Military Affairs, the Secretary of War under date of June 28 made a written statement in regard to the progress of various military activities.

Under the head of aircraft production, including training planes, bombing planes, combat planes and guns therefor, and production of Liberty engines, Secretary Baker gives the following figures:

"Deliveries of elementary training planes to June 8, 4495; deliveries of advanced training planes to June 8, 820.

"The average weekly production of advanced training planes during April was 22; during May was 45½; week ending June 8 was 78.

"To June 8, 286 combat planes were delivered. The weekly average of this type of machine in April was 5; in May, 38; and for the week ending June 8 was 80.

"Six thousand eight hundred and eighty elementary training engines were delivered to June 8; 2133 advanced training engines were delivered to same date.

"More than 2000 Liberty engines have now been delivered to the Army and the Navy. The average weekly production in April was 96, in May 143, and in the first week of June 115.

"Thirty-seven thousand two hundred and fifty machine guns were delivered for use on airplanes before June 8."

Maximum Fir Prices

Following a conference with the loggers and lumber manufacturers of the Pacific Northwest the Price Fixing Committee of the War Industries Board has established the following maximum prices for a period of ninety days from June 15:

Fir logs delivered at customary points to sawmill operators: No. 1, $20 per thousand; No. 2, $16, and No. 3, $12 for 40-ft. lengths; over 40 ft., price to be on same basis as established by custom or as decided by the Lumber Section of the Board.

Prices of fir lumber for aircraft use are to remain the same as now.

These prices represent an average increase of approximately $2.75 per 1000 board feet over former prices to the Government and are f.o.b. mill.

Contracts are to be made always subject to an option by the Government, under which option supplies will be allocated either to the Government or to other essential users to any extent required.

Du Pont Gives Y. M. C. A. Airplane

Irenee Du Pont, head of the Du Pont interests at Wilmington, Del., has presented to the School for Airplane Mechanics, conducted by West Side Y. M. C. A., of 318 West Fifty-seventh street, New York City, a complete airplane, which is to be brought here for the use of the school. F. F. Tenney, principal, and W. D. Davis, instructor, have gone to Claymont, Del., to inspect the gift and bring it here, in the air if practicable, to save transportation. The plane is a Curtiss J. N.-4 military tractor biplane. Mr. Du Pont's letter announcing the gift says among other things: "We have concluded, in view of the national importance of your school, that we will make a donation of the machine to you."

The School for Airplane Mechanics has grown so rapidly since it was opened last fall that it has been necessary to rent additional quarters. Part of the building at 240 West Fifty-third street has been in use from the beginning and is in operation from 8 a. m. till 11 p. m. daily except Sunday. In June 221 students were enrolled, a total of 921 for the seven months. The new quarters are at 239 West Fifty-sixth street. The plane instruction will be given here, the old school being devoted to engine work.

Anglo-Norwegian Air Mail Planned

The submarine warfare has made the sea mails so irregular across the North Sea that the scheme for an airplane service is being energetically pushed forward by a Norwegian company with the backing of the Norwegian Government. The journey across the North Sea has already been made in five hours, and it is estimated that, in a regular service, the ordinary average time would be under 4½ hr.

The British Government, while it has no airplanes to spare for such purposes in war time, is prepared to give the Norwegian company every facility.

Airships — Military Kite
and Spherical Balloons
Cord Tires for Airplanes
Rubber Accessories for Airplanes

Everything in Rubber for the Airplane
Balloons of Any Size and Every Type

GOODYEAR
AKRON

SIMPLEX
ELECTRICALLY HEATED AVIATOR'S CLOTHING

Doubles the Animal warmth of the body and distributes the surplus just where it is needed around the face and on the hands and feet.

The heaters are so flexible that their location is difficult to detect except by the heat they produce.

SIMPLEX ELECTRIC HEATING CO.
85 SIDNEY STREET, CAMBRIDGE, MASSACHUSETTS, U.S.A.
MANUFACTURERS OF EVERYTHING INVOLVING ELECTRIC HEAT

Thomas

THOMAS-MORSE AIRCRAFT CORPORATION

ITHACA, N.Y. U.S.A.

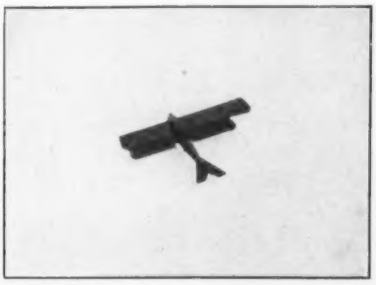
Contractors to U. S. Government

FOR SALE

3 New Tractor Airplanes, with or without engines.
1 Used Tractor Airplane, equipped with engine.
2 New Flying Boats, equipped with engines.
2 Used Flying Boats, equipped with engines.

All in perfect condition. Prices range from $5200 to $11300

Address Box 12, AVIATION AND AERONAUTICAL ENGINEERING
120 West 32d Street, New York



IN THE AIR

Calls for

Speed—Strength—Ease of Control

In addition to these vital requisites the new Continental Pusher offers wide range of vision for Observer, Camera Man or Gunner.

The Continental Aircraft Corporation

Factory and Aviation Field
AMITYVILLE, L. I.

New York Office
120 LIBERTY STREET

MANUFACTURERS OF

Airplanes, Experimental Airplanes and Parts

WITTEMANN-LEWIS AIRCRAFT COMPANY

NEWARK, N. J.

Main Office and Factory:

Lincoln Highway
near Passaic River

Telephone, Market 9096

The HOLBROOK Co.

New York City

MANUFACTURERS

Airplane Propellers
Airplane Sheet Aluminum Parts
Airplane Sheet Metal Parts
Airplane Woodwork
Airplane Upholstery

Again—

The United States Bureau of Standards says:—

About CLEAR WHITE RESISTAL. "In view of the tenacity with which celluloid holds glass and prevents it from shattering, the slightly lower light transmission of such a combination is probably compensated by the superior protection offered to the eyes in case of accident to the goggles."

About ANTI-GLARE RESISTAL. "The yellow tinted goggles are opaque to violet light but highly transparent to green, yellow and red. This type of glass should aid vision through haze and smoke, since it screens off the light which is scattered most."

RESISTAL EYETECTS

The Guaranteed Non-Shatterable Aviator Goggles

They will not destroy, reduce, distort or impair the vision in any way, no matter when, where or for what length of time they may be continually worn. Specifically, this guarantees that the wearer of Resistal Goggles will pass the standard vision tests of the U. S. Aviator (Army or Navy as well with Resistal Goggles as he may have without any goggles before his eyes. Send for free test pieces and the U. S. Bureau of Standards Report of March 25th and Supplemental Report of May 9th.

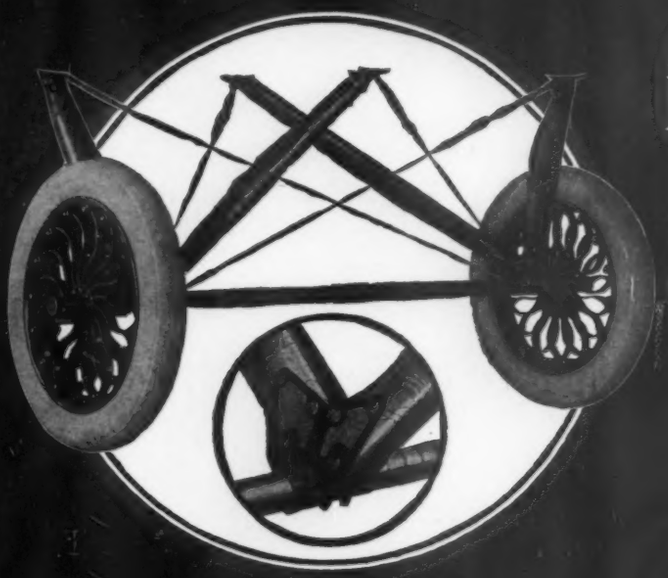
Aviators Everywhere Insist Upon RESISTAL

RESISTAL S.&B.N.Y.

STRAUSS & BUEGELEISEN

Sole Manufacturers

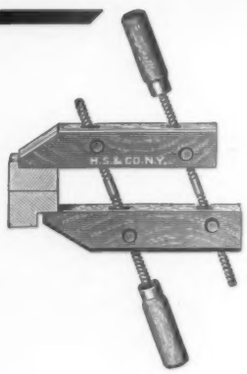
438 Broadway **New York City**

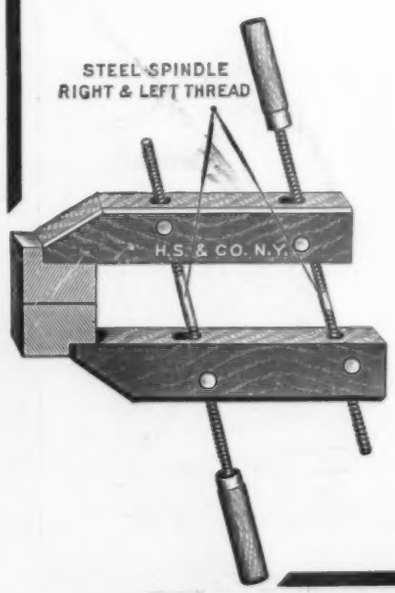


ACKERMAN LANDING GEAR

SIMPLICITY
STRENGTH
SERVICE

THE ACKERMAN WHEEL COMPANY
542 Rockefeller Building, CLEVELAND, OHIO. U.S.A.





THE JORGENSEN PATENT

ADJUSTABLE HAND SCREW

is the first real improvement in years over the old style Wood Hand Screw.

JAWS CAN BE ADJUSTED TO ANY ANGLE. This is a decided advantage, as it saves the time usually spent in squaring up irregular surfaces. A *single clamp* will adjust to any of the positions shown, or any modification of them. One jaw can also be made to overlap the other.

SEND FOR SPECIAL CIRCULAR NO. 161

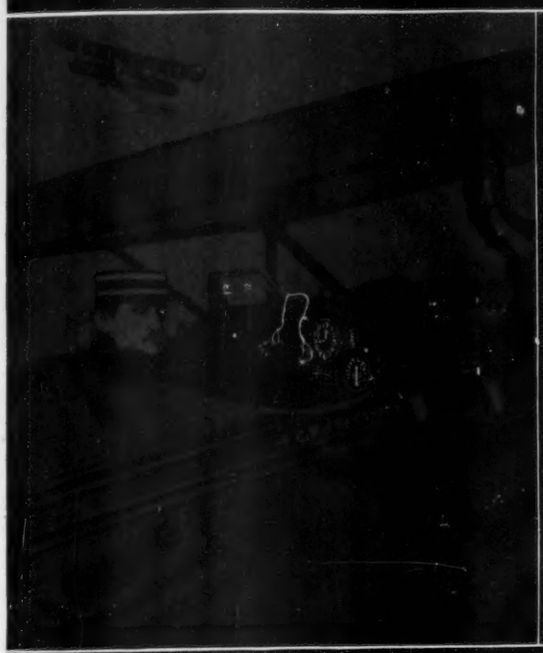
HAMMACHER, SCHLEMMER & CO.

HARDWARE, TOOLS AND SUPPLIES

New York, Since 1848 Fourth Avenue and 13th Street

WE USE THE CELEBRATED

LUMA Radium Luminous Compound

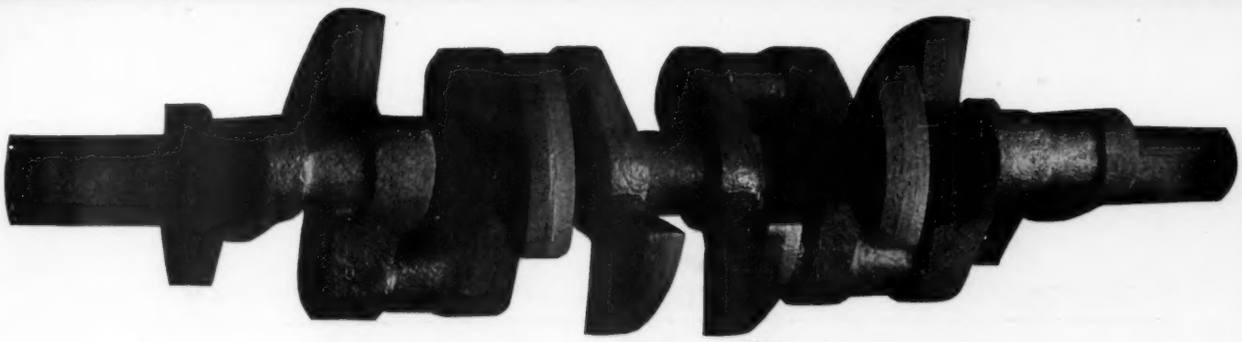


Visible in the Dark

Luma-Lighted dials are visible in the dark.
The air pilot can read his instruments at all times. There is no uncertainity; no danger of Luma "going out."
This wonderful Radium luminous material is now being used by many of the largest manufacturers of dash instruments. It meets the requirements of the British Admiralty and specifications of the United States Government for use on military aircraft instruments.
This Company has unusual facilities for applying Luma to dials of every description. The service is convenient and economical for manufacturers and assures uniformly satisfactory results.

Write for booklet and full information.

RADIUM DIAL COMPANY
GENERAL OFFICES - PITTSBURGH, PA.
501 FIFTH AVE. NEW YORK - MARSHALL-FIELD ANNEX BLDG. CHICAGO
DIAL PRINTING FACTORIES, PITTSBURGH, LONG ISLAND CITY, N.Y., CHICAGO



a counterbalanced aviation crankshaft . . . .

Patented July 10th, 1917

one of the 18 different
models we are now making
for 14 aviation motor companies . . .
reduces vibration and eliminates bearing pressure

We have shipped 63,759 Counterbalanced Crankshafts to July 9, 1918

THE PARK DROP FORGE CO. CLEVELAND, OHIO

P. PRYIBIL MACHINE COMPANY

MANUFACTURERS OF

FINE WOOD WORKING MACHINES

WE HAVE SERVED

CURTISS ENGINEERING CORPORATION
L. W. F. ENGINEERING COMPANY
WRIGHT-MARTIN AIRCRAFT CORPORATION
STANDARD AIRCRAFT CORPORATION
CONTINENTAL AIRCRAFT COMPANY

Why not you?

Factory, 512-524 West 41st Street, New York City
Established 1862

WIDMAN

Manufacturers of

Waterproof Ply Wood Panels of All Thicknesses and Plies

Stand Highest in Government Tests for
Strength and Water Resisting Qualities

FABRICATORS OF PARTS OF ALL KINDS

OUR ENGINEERING DEPARTMENT IS AT YOUR SERVICE

Sales Agents for Certus Glue

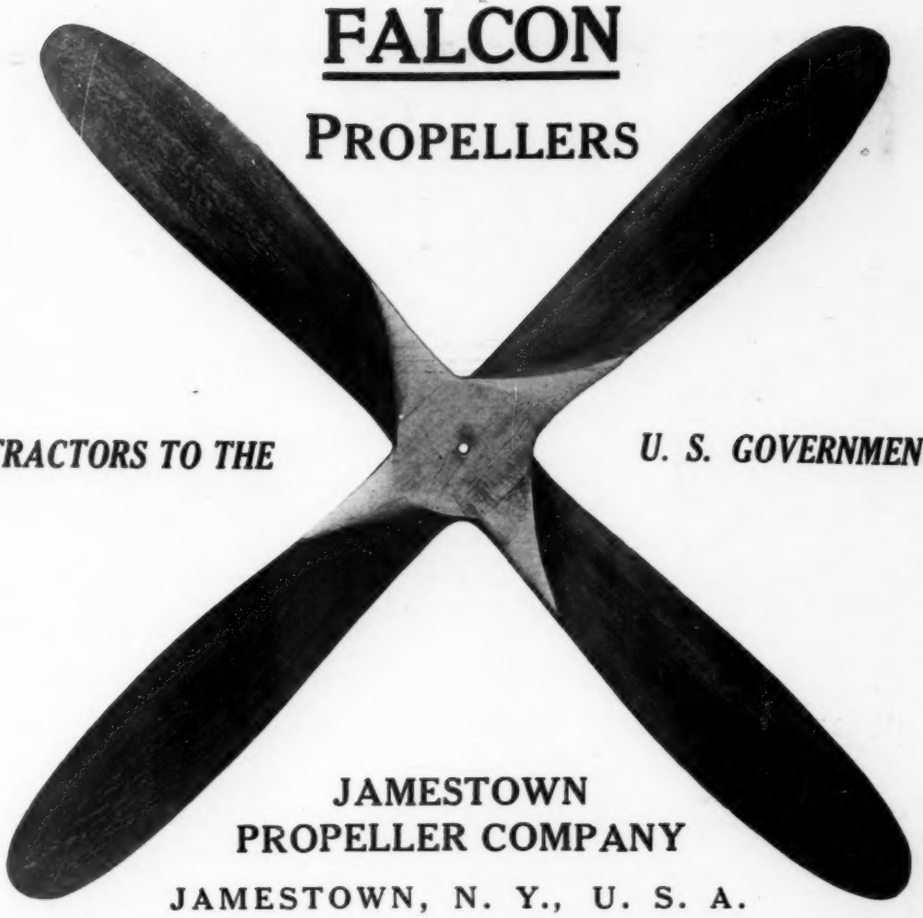
Absolutely Waterproof and accepted by the Government

J. C. WIDMAN & COMPANY

Fourteenth and Kirby Avenue **Detroit, Michigan**

FALCON

PROPELLERS



CONTRACTORS TO THE *U. S. GOVERNMENT*

JAMESTOWN
PROPELLER COMPANY

JAMESTOWN, N. Y., U. S. A.

AIR PLANE DRY KILNS

We are prepared to design, equip, install and operate according to Aircraft Engineering Division Specification No. 20,500-A.

I. ***Grand Rapids Vapor Process Kilns*** (as perfected thru the erection of 2,000 kilns in high class woodworking plants).

II. ***Tiemann Humidity Regulated Kilns*** (as designed and developed by the Forest Products Laboratory at Madison, Wisconsin).

III. ***Tiemann-Grand Rapids Combination Kilns*** (combining the scientific points of the Tiemann kiln with the practical experience of the Grand Rapids Veneer Works, subject to operation by either method).

Batteries of combination *Grand Rapids-Tiemann* kilns have just been selected and purchased for the *United States Government* Experimental Department at McCook Field and for the *United States Government* Aircraft Repair plant "Somewhere in France."

In addition we have designed or equipped kilns for:—

STANDARD AIRCRAFT CORPORATION, 2 orders
FISHER BODY CORPORATION, 2 orders
THOMAS-MORSE AIRCRAFT CORPORATION
AMERICAN PROPELLER & MFG. COMPANY
BREESE AIRCRAFT COMPANY
BRIGGS AEROPLANE COMPANY
WEST WOODWORKING COMPANY
FLOTTORP MANUFACTURING COMPANY
GALLAUDET AIRCRAFT CORPORATION
WEST VIRGINIA AIRCRAFT COMPANY

Submit your drying problem to experts who make a specialty of kiln design and are prepared to furnish and install all equipment and instruments

GRAND RAPIDS VENEER WORKS

Grand Rapids, Michigan **Seattle, Washington**

TEXTILE MACHINE WORKS

READING, PA.

MANUFACTURERS OF

Machinery and High Grade Machinery Castings

800 Employees, Foundry Capacity 60,000 lbs. per day

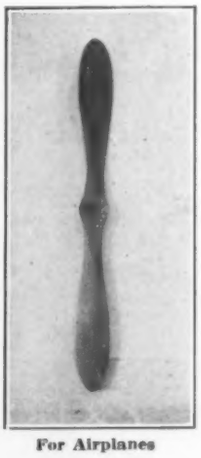
Shop equipped with all Modern Machine Tools and Automatics for Quantity Production and Precision Work

JACUZZI BROTHERS

2034 San Pablo Avenue, Berkeley, Calif.

Propeller Manufacturers

For Airships



For Airplanes

OVER TWENTY TYPES OF PROPELLERS ARE MANUFACTURED CONTINUALLY AT OUR PLANT

WE DESIGN PROPELLERS TO MEET DIFFERENT REQUIREMENTS

Write for our price list

Designed and Built to meet the exacting requirements of
Airplane Service
combining
Light Weight
Efficiency and
Durability
Diagonal and Square Honeycomb Types. One Quality Only—The Best
Our engineering experience and up-to-the-minute manufacturing facilities are at your disposal.
The G & O Mfg. Co.
New Haven, Conn., U. S. A.
G&O
Radiators

Factors of Safety

These Count in Aeroplane Construction

NON-INFLAMMABLE

Cellulose Acetate Base

Celestron Cloth Varnishes

provide another SAFETY FACTOR

NON-INFLAMMABLE

Celestron Sheets AND Films

Transparent — Waterproof

MANUFACTURED BY

Chemical Products Company

93 Broad Street **Boston, U. S. A.**

Manufacturers of Cellulose Acetate for nearly 15 years

GROVER C. LOENING

Announces

THE NEW 1918 EDITION

ENLARGED

and

SIMPLIFIED

Of his extensively used textbook

Military Aeroplanes

Almost doubled in size and with the finest halftone and linecuts available

For sale
GROVER C. LOENING
45 Eleventh St.
Long Island City, N. Y.

Price $4.75

Air Speed Indicators

Altimeters

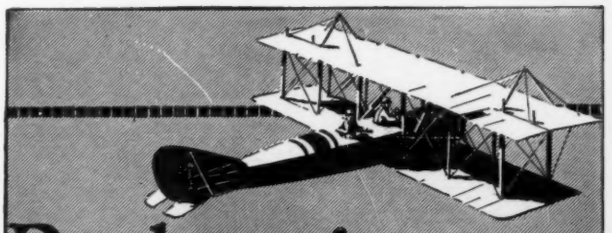
Barographs

Compasses, etc.

International Aeronautical Instrument Corporation

(Formerly A. HAUSTETTER)

308 Madison Avenue **New York**



Baker's A-A Castor Oil

Specially Refined
for the Lubrication of
AERONAUTICAL MOTORS

BAKER CASTOR OIL CO.

Founded 1857

The Oldest and Largest Manufacturers of Castor Oil in the United States

120 BROADWAY - - - NEW YORK

"The Cavalry of the Clouds and The Navy That Flies"

are now being given exclusive and intimate expression through the

Air Service Journal

the official publication of the *Air Service Association* — the only service organization of the aviation branches of the Army and Navy.

The Association was organized within the service, by flying officers, who elected their own officers, and its membership is made up of the men who are fighting and will fight our air battles.

In addition to the established editorial features of AIR SERVICE JOURNAL—all the news of the Air Services each week, foreign aeronautical news, notes of the flying fields and ground schools, Air Service orders, special articles on aeronautical subjects, and photographs of aerial happenings all over the world—it will feature exclusive articles by officers of the Air Services through the editorial board of the Air Service Association.

Special offer to new subscribers—two dollars a year, 52 issues; or one dollar for six months, 26 issues. Regular price three dollars, single copies ten cents

THE GARDNER-MOFFAT CO.
INCORPORATED
120 West 32d Street New York City

THE GARDNER-MOFFAT COMPANY
120 West 32d Street, New York City

Enclosed is { money order / check } for ..... dollars for which send me AIR SERVICE JOURNAL for { one year. / six months.

Name .....

Address .....

.....

AVIATION 7-15

Aluminum Company of America
PITTSBURGH, PA.

MANUFACTURERS OF

Aluminum Ingot, Sheet, Tubing, Wire, Rod, Rivets, Moulding Extruded Shapes, Electrical Conductors

GENERAL SALES OFFICE,
2400 Oliver Building, Pittsburgh, Pa.

BRANCH OFFICES:

Boston.....131 State Street
Chicago.....1500 Westminster Building
Cleveland.....950 Leader-News Building
Detroit .....1512 Ford Building
Kansas City.....308 R. A. Long Building
New York .....120 Broadway
Philadelphia....1216-1218 Widener Building
Rochester .....1112 Granite Building
San Francisco.....731 Rialto Building
Washington..509 Metropolitan Bank Bldg.

CANADA
Northern Aluminum Co., Ltd.....Toronto

LATIN AMERICA
Aluminum Co. of So. Am...Pittsburgh, Pa.

ENGLAND
Northern Aluminium Co., Ltd.....London

Send inquiries regarding aluminum in any form to nearest Branch Office, or to General Sales Office

We have received two notices from the Government:

1. *"Your application for a license is disapproved."*
2. *"Since your Penguin does not leave the ground there is nothing, of course, to stop the use of them."*

Wherefore,

YOU MAY LEARN TO FLY BY THE BEECH FLIGHT SYSTEM

PROCEDURE:

You apply for a license for the purpose of making practice flights on Salt Plains, Oklahoma, to the Joint Army and Navy Board for Aeronautic Cognizance, 1607 H. Street, N. W., Washington, D. C.

You then pay us a fee of $125, for which we prepare you to the point where you may safely go up alone in our airplane, which we rent you for 65c. each minute of actual flight, including the cost of breakage, with the proviso that you follow our instructions; because, while our Penguin practice makes the operation of the airplane in the air an easy matter, there still remain the principles of the landing to teach, which is easy by our system providing instructions are followed.

The Beech Flight System Corp.
Cherokee, Oklahoma

Aeronautical Trade Directory

AVIATION AND AERONAUTICAL ENGINEERING will furnish information and addresses of companies listed below.

Names of Advertisers in this issue are printed in capitals.

See Index to Advertisers on page 904

ACCESSORIES AND INSTRUMENTS

Advance Felt Specialty & Cutting Co.
INTERNATION AERONAUTICAL INSTRUMENT CORP.
King, Julius, Optical Co.
The Moto-Meter Co.
National Gauge & Equipment Co.
O'Hara Waltham Dial Co.
Rieker, Walter.
SPERRY GYROSCOPE CO.
Standard Aeronautical Co.
TAYLOR INSTRUMENT COMPANIES
Western Electric Co.

AIRPLANES

Aeromarine Plane and Motor Co.
Blackhawk Airplane Co.
Boeing Airplane Co.
Breese Aircraft Corp.
THE BURGESS COMPANY.
California Aviation Co.
Cooper, John D., Aeroplane Co.
CURTISS AEROPLANE & MOTOR CORP.
Dayton Wright Airplane Co.
Des Lauriers Aircraft Corp.
Dewey Aeroplane Co.
Engel Aircraft Co.
Falcon Mfg. Co.
Fisher Body Corp.
Fowler Airplane Corp.
Gallaudet Aircraft Corp.
Heinrich, A. S., Corp.
Lanzius Aircraft Co.
Lawrence-Lewis Aeroplane Co.
LAWSON AIRCRAFT CORP.
Lewis & Vought Corp.
Loening Aeronautical Eng. Corp.
Longren Aeroplane Co.
L. W. F. ENGINEERING CO.
MARTIN, GLENN L., CO.
Michigan Aircraft Corp.
ORDNANCE ENG'RING CORP.
Patterson Aeroplane Co.
Peirce, Sam'l S., Aeroplane Corp.
Smith, Kyle, Aircraft Co.
Sperry, Lawrence, Aircraft Co.
Springfield Airplane Co.
STANDARD AIRCRAFT CORP.
Sturtevant Aeroplane Co.
THOMAS-MORSE AIRCRAFT CORP.
The Willys-Morrow Co.
WITTEMANN-LEWIS AIRCRAFT CO.
Whittemore-Hamm Co.
Wright-Martin Aircraft Corp.

AIRPLANE ENGINES

Aeromarine Plane and Motor Co.
Ashmusen Mfg. Co.
Continental Motors Co.
CURTISS AEROPLANE & MOTOR CORP.
Dayton Aero Motors Co.
Detroit Gas Turbine Corp.
DUESENBERG MOTOR CORP.
General Ordnance Co.
General Vehicle Co.
Gyro Motor Co.
HALL-SCOTT MOTOR CAR CO.
Kemp Machine Works.
Kessler Motor Co.
Knox Motors Co.
Nordyke & Marmon.
Packard Motor Co.
Roberts Motor Mfg. Co.
Rolls-Royce, Ltd.
Springfield Motors Co.
Sterling Engine Co.
Sturtevant, B. F., Co.
Trego Motors Corp.
THOMAS - MORSE AIRCRAFT CORP.
UNION GAS ENGINE CO.
Van Blerck Motor Co.
Willys-Overland Co.
WISCONSIN MOTOR MFG. CO.
World's Motor Co.
Wright-Martin Aircraft Corp.

AIRPLANE PARTS

Aircraft Parts Mfg. Co.
American Body Co.
Astoria Veneer Mill & Dock Co.
BARCALO MFG. CO.
Century Telephone Construction Co.
Chicago Aeronautical Supply Co.
DAYTON METAL PRODUCTS CO.
ERIE SPECIALTY CO.
HOLBROOK CO.
Kawneer Mfg. Co.
Levett, Walker M., Co.
New Jersey Veneer Co.
Pressed & Welded Steel Products Co.
Rogers Construction Co.
Standard Parts Co.
Welch Mfg. Co.
Whittemore-Hamm Co.
WIDMAN, J. C., & CO.
Willys-Morrow Co.
Wilson Cabinet Co.

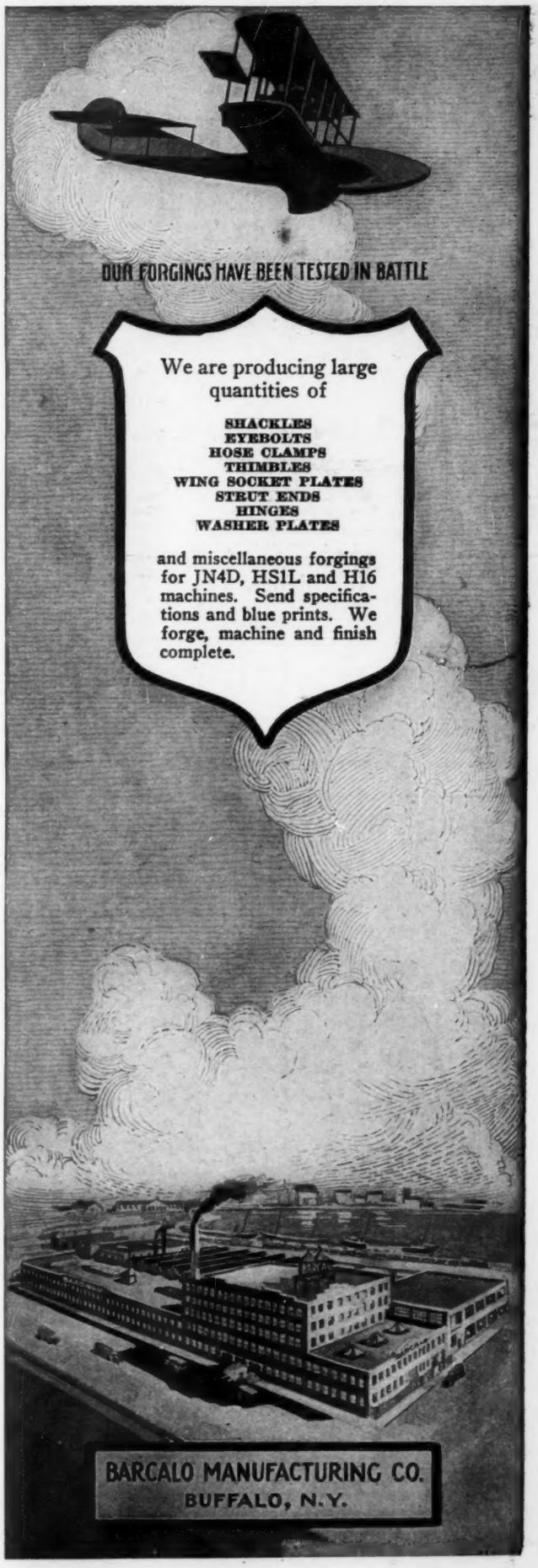
ALUMINUM

Acieral Co. of America
Aluminum Castings Co.
ALUMINUM CO. OF AMERICA
American Metal Co., Ltd.
Levett, Walker M., Co.
LEYGRAND & CO.
McAdamite-Aluminum Co.
SO-LUMINUM MFG. & ENG. CO. (SOLDER)
STIMPSON, EDWIN B., CO.
United Smelting & Aluminum Co.

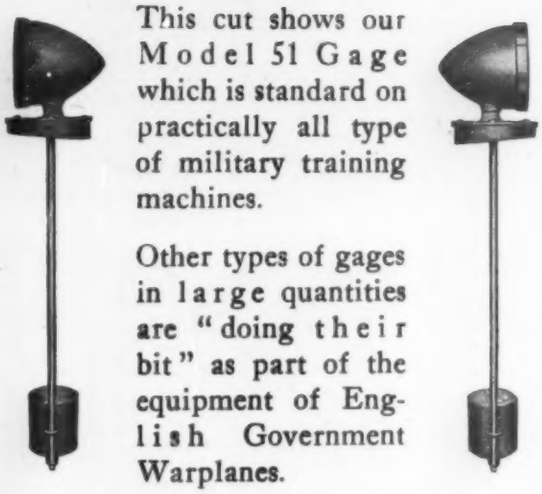
AVIATION SCHOOLS

American School of Aviation
America Trans-Oceanic Co.
ATLANTIC COAST AERONAUTICAL STATION
Beam Airplane Co.
Blackhawk Airplane Co.
CURTISS TRAINING SCHOOLS
EAGLE AVIATION SCHOOL
The Hydrerocraft Co.
Michigan State Auto School
Moler Aviation Instructors
Penn. State School of Aero-Mechanics
Stinson School of Aviation
Whittemore-Hamm Co.

(*Continued on page 893*)



FUEL LEVEL GAGES



This cut shows our Model 51 Gage which is standard on practically all type of military training machines.

Other types of gages in large quantities are "doing their bit" as part of the equipment of English Government Warplanes.

SPECIAL TYPES DESIGNED FOR YOUR ESPECIAL NEEDS.

BOSTON AUTO GAGE CO.

8 WALTHAM STREET, BOSTON, MASS.

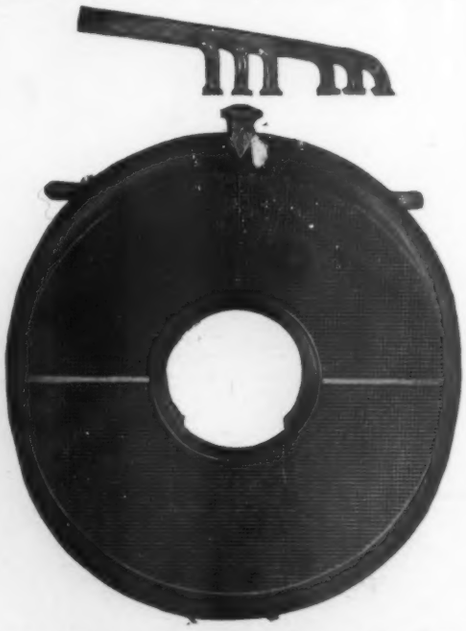
ROME AERONAUTICAL RADIATORS

Developed from years of experience in building all types of radiators.
They possess every feature and qualification necessary for a high grade product.

STRONG
EFFICIENT
DURABLE

Used on the best American flying machines.
Our engineering department is at your service.

Rome-Turney Radiator Company
Rome, N. Y., U. S. A.



AJAX Auto and Aero Sheet Metal Company
Manufacturers and designers of
AERO RADIATORS INTAKE and EXHAUST PIPES
H. W. MEYER, 245 West Fifty-fifth Street, New York

"Flexo" Aero RADIATORS

The only core that will stand severe landing shocks.

No sharp corners to crystallize through vibration.

The only core that can be so bent without injury to the metal or soldered joints.

"FLEXO"—PATENTED

FLEXO MANUFACTURING CO.

1313-1320 E. 12th STREET LOS ANGELES, CAL.

Aeronautical Trade Directory—*Continued*

BALL BEARINGS
The Fafnir Bearing Co.
Gurney Ball Bearing Co.
Hess-Bright Mfg. Co.
NEW DEPARTURE MFG. CO.
NORMA COMPANY OF AMERICA
S. K. F. Ball Bearing Co.
U. S. Ball Bearing Mfg. Co.

BALLOONS: DIRIGIBLES
Burdette Oxygen Co.
Connecticut Aircraft Co.
Custer Specialty Co. (Statoscope)
Gas Engineering Co. (Gas Plants)
GOODYEAR TIRE AND RUBBER CO.
United States Rubber Co.

BAROGRAPHS AND BAROMETERS
Green, Henry J.
INTERNATIONAL AERONAUTICAL INSTRUMENT CORP.
Sussfield & Lorch
TAYLOR INSTRUMENT COMPANIES

BEARING METALS
Aluminum Castings Co.
American Bronze Corp.
FAHRIG METAL CO.
Levett, Walker M., Co.
Magnolia Metal Co.

BUSHINGS
Aluminum Castings Co.
American Bronze Corp.
Bound Brook Oil-less Bearing Co.

CARBURETORS
H. & N. Mfg. Co.
Master Carburetor Co.
Miller Carburetor Co.
Stromberg Motor Devices Co.
Wheeler & Schebler
ZENITH CARBURETOR CO.

CLOCKS AND WATCHES
Chelsea Clock Co.
Depollier, J., & Son
Hamilton Watch Co.
Ingersoll, Robert H., & Bros.
Waltham Watch Co.

CLOTHING
Abercrombie & Fitch
Cross, Mark
N. Y. Sporting Goods Co.
Rainwear Co.
Rogers, Peet & Co.
Sanders Company
Spalding, A. G., & Bros.

COMPASSES
SPERRY GYROSCOPE CO.
Star Compass Co.
TAYLOR INSTRUMENT COMPANIES

DOPE AND VARNISH
Adams & Elting Co.
American Emaillite Co.
Brooklyn Varnish Mfg. Co.
CHEMICAL PRODUCTS CO.
Conover, The C. E., Co.
Du Pont Chemical Works
Flexible Compound Co.
Harland, Wm., & Son
Howe Varnish Co.
Lucas, John, Company
Masury, John W., & Son
Perry-Austen Company
Pratt & Lambert
Sherwin-Williams Co.
Smith, Edward, & Co.
Standard Varnish Works
Valentine & Company
Weeks & Co.

DRIFT INDICATOR
SPERRY GYROSCOPE CO.

DRY KILNS
Cutler Dry Kiln Co.
GRAND RAPIDS VENEER WORKS

DYNAMOMETER
Sprague Electric Works

ENGINE PARTS
Allegheny Forging Co.
Aluminum Castings Co.
Anderson Forge & Machine Co.
BARCALO MFG. CO.
Burd High Compression Ring Co.
Crosby Steam Gage & Valve Co.
Dallet, Thos. H., Co.
DOEHLER DIE CASTING CO.
ERIE SPECIALTY CO.
Fibre Finishing Co.
Gifford, Leland, Co.
Gill, P. H., & Sons
Hayes Mfg. Co.
Hydraulic Pressed Steel Co.
Levett, Walker M., Co.
Meisel Press Mfg. Co.
PARK DROP FORGE CO.
Pressed & Welded Steel Products Co.
Standard Parts Co.
STIMPSON, EDWIN B., CO.
Taft-Peirce Mfg. Co.
TIOGA STEEL & IRON CO.
Williams, J. H., & Co.
WHITMAN & BARNES MFG. CO.
WYMAN-GORDON CO.

ENGINEERING
AUTOMOTIVE ENGINEERING CO.
ORDNANCE ENGINEERING CO.
White, J. G., Engineering Corp.

FABRICS
Courtrai Mfg. Co.
Hutchinson, Scott Co.
Lamb, Finlay & Co.
McBratney, Robt., & Co.
Whitman, Clarence & Co.

FELT
Advance Felt Specialty & Cutting Co.
Booth Felt Co.
Western Felt Works

FIRE EXTINGUISHERS
Fyr-Fyter Co.
Johns-Manville, H. W., Co.
Pyrene Mfg. Co.

GAGES
Advance Felt Specialty & Cutting Co.
BOSTON AUTO GAUGE CO.
Crosby Steam Gauge & Valve Co.
FOXBORO CO., INC.
Greenfield Tap & Die Corp.
United States Gage Co.

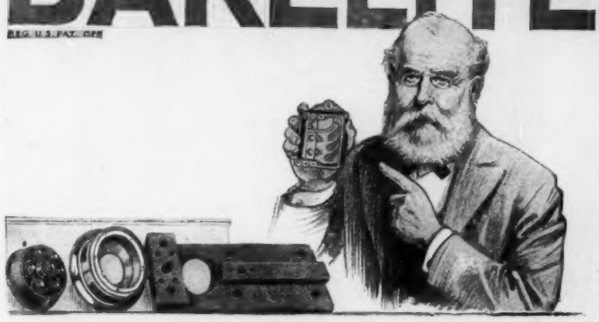
GASKETS
Advance Felt Specialty & Cutting Co.
Booth Felt Co.
Fibre Finishing Co.

GLUE
Armour Glue Works
Baeder & Adamson
FERDINAND, L. W., & CO.
WIDMAN, J. C., CO.

(*Continued on page* 895)

BAKELITE

REG. U.S. PAT. OFF.

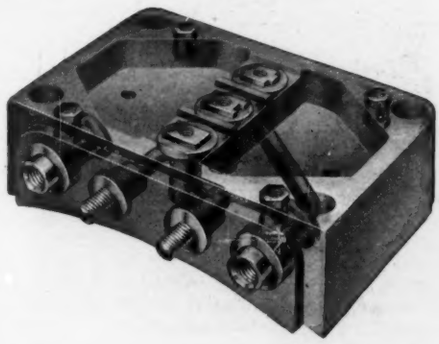


Metal Parts May Be Moulded Into Bakelite

"BAKELITE Moulding Materials are plastics which are readily fusible, admitting of easy and accurate placing of inserts of any metal of any shape at any angle. Their original forms are either granular powders or plastic sheets.

When the moulded article leaves the hydraulic press the metal inserts are permanently incorporated in it without any further processing. This obviates the necessity for all such machine operations as drilling, tapping, reaming, threading, etc.

Bakelite is mechanically and dielectrically strong and chemically inert. It is unaffected by water, steam, oils, solvents and most chemicals."



The GENERAL BAKELITE COMPANY
2 Rector Street, New York, welcomes inquiries from manufacturers and maintains a research laboratory for the working out of new applications including those pertaining to flying machines.

2001-B

THE No. 613 DEFIANCE AEROPLANE PROPELLER TURNING LATHE

TAKES THE PLACE OF EIGHT TO TEN SKILLED WORKMEN

IT'S conserving man power. Each Defiance Aeroplane Propeller Turning Lathe releases from eight to ten skilled workmen for other duties. With one man operating a number of machines, the cost of working propeller blades close to size is cut to little or no consideration—a big saving that's added to profits. This machine is in use in England, in Italy, in Canada—it is used by the United States Government. Installations by twelve of the leading propeller manufacturers in America endorses this machine as the most practical and economical method of shaping propeller blades. It's a high productive machine, made to keep pace with present day requirements, either in output, accuracy, or production cost. It will turn propeller blades of various sizes—to any shape or pitch—and leaves but the final finishing to be done by hand. It will duplicate struts, as well as propellers, of irregular shape to exactness.

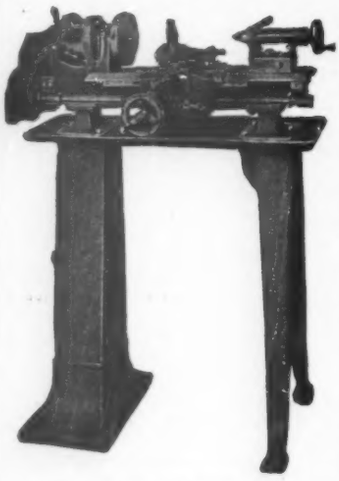
An illustrated and descriptive circular of this machine will be mailed on request.

THE DEFIANCE MACHINE WORKS

DEFIANCE, OHIO, U. S. A.

NEW YORK *LONDON*

"DALTON SIX"



In the Manufacture of Aeroplanes or the many small parts comprising a Unit

"Dalton Six"

is indispensable.

Furnished for English or Metric Thread Cutting.

One Manufacturer of fine instruments for aeroplanes now has

(36) "DALTON SIXES" Installed

Why Not Investigate?

BULLETIN B602C GIVES DETAILS

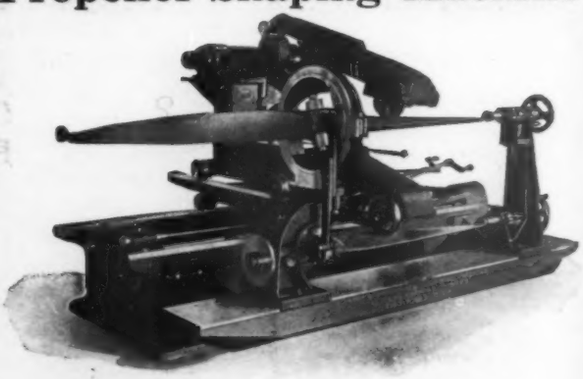
Dalton Manufacturing Corp.

Successors to Dalton Mach. Co., Inc.

1911 Park Avenue New York, U. S. A.

MATTISON

Propeller Shaping Machine



For Two, Three and Four-Bladed Screws

A brand new machine—designed and built with the thoroughness characteristic of all Mattison woodworking machines—which has been approved by many of America's largest propeller manufacturers.

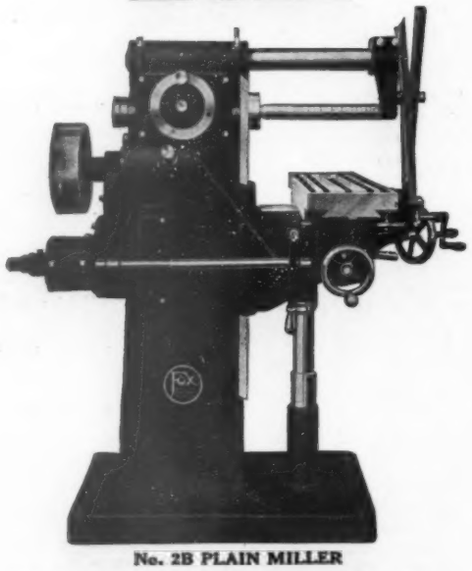
It works close to finish-size, thereby eliminating the greater part of the expensive hand work which usually follows the machining operation of other methods.

Write or Wire for Details

MATTISON MACHINE WORKS

879 FIFTH STREET BELOIT, WISCONSIN

FOX



No. 2B PLAIN MILLER

Single Pulley Drive

12 changes to spindle speeds
6 changes to each spindle speed

No. 9 taper in spindle.
Table 8½ x 37"

Hardened machine steel gears throughout insure maximum driving power at all speeds.

We also build Universal Millers, Dividing Heads, Vertical Attachments and Vises.

Write for Circular

THE FOX MACHINE COMPANY

1810 W. Gavson St., Jackson, Mich.

Formerly of Grand Rapids, Mich.

Aeronautical Trade Directory—*Continued*

GOGGLES

Hardy, F. A. Co.
Meyrowitz, E. B.
STRAUSS & BUEGELEISEN
Strong, Kennard & Nutt
Triplex Safety Glass Corp.
Willson, T. A., & Co., Inc.

HANGARS

American Bridge Co.
Anchor Corrugating Construction Co.
Ashley Steel Bldg. Co.
Austin Co., The
Barney, John M.
Howell, Field & Goddard, Inc.
Keasby & Mattison
Milliken Brothers
Pruden, The C. D., Co.
Steel Fabricating Co., The
Virginia Bridge & Iron Co.

HOISTS

Yale & Towne Mfg. Co.

LIFE PRESERVERS

Robinson-Roders Co.
Universal Safety Mattress Co.

LUMBER

Alcock Co., John L.
American Balsa Corp.
Astoria Veneer Mills & Dock Co.
Chetham Lumber Co.
Delatour, J.
Dutton, A. C., Lumber Corp.
Ludlow, Israel
Mengel, C. C., & Bros. Co.
New Jersey Veneer Co.
Sheip & Vandergrift

LUMINOUS COMPOUND

COLD LIGHT MFG. CO.
Cummings, W. L., Chemical Co.
RADIUM DIAL CO.
RADIUM LUMINOUS MATERIAL CORP.

MACHINERY, METAL WORKING

DALTON MFG. CORP.
DEFIANCE MACHINE WORKS
FOX MACHINE CO.
Warner & Swasey Co.

MACHINERY, WOOD-WORKING

Curtis Machine Corp.
DEFIANCE MACHINE WORKS
Fay, J. A., & Egan Co.
FOX MACHINE CO.
Machinery Merchants, Inc.
MATTISON, C., MACHINE WORKS
Olney & Warrin
PRYIBIL, P., MACHINE CO.
YATES, P. B., MACHINE CO.

MAGNETOS

Berkshire Magneto Corp.
Bosch Magneto Co.
ERICSSON MFG. CO.
Remy Electric Co.
Splitdorf Electrical Co.

MANIFOLDS

AJAX AUTO & AERO SHEET METAL CO.
Pressed & Welded Steel Products Co.

METALS

Acieral Co. of America
American Bronze Corp.
American Vanadium Co.
Bethlehem Steel Co.
BETZ-PIERCE CO., THE
BLUM, JULIUS & CO.
Detroit Pressed Steel Co.
Federal Pressed Steel Co.
Garland Ventilator Co.
Gueder, Paeschke & Frey Co.
Kawneer Mfg. Co.
La Salle Steel Co.
Levett, Walker M., Co.
Rumford Metal Co.
SO-LUMINUM MFG. & ENG. CO.
Standard Alloys Co.
Steel Sales Corp.
Steel Products Co.
STIMPSON, EDWIN B., CO.
Wheeler, Frank H., & Son

MODEL AIRPLANES

Ideal Aeroplane Supply Co.
Wading River Mfg. Co.

MOTORCYCLES

Excelsior Motor Mfg. Supply Co.
HENDEE MFG. CO.
Harley-Davidson Co.
Militare Motor Vehicle Co. of America

OILS AND LUBRICANTS

BAKER CASTOR OIL CO.
Graphite Lubricant Co.
Gulf Refining Co.
Sheppard Ideal Oil Co.
Sun Co., The
Standard Oil Co.
Swan & Finch
Texas Co., The
Vacuum Oil Co.
WAKEFIELD, C. C., & CO., LTD.

PACKING

Advance Felt Specialty & Cutting Co.
Booth Felt Co.
Fibre Finishing Co.

PHOTOGRAPHY

BROCK, ARTHUR, JR.
Herbert & Huesgen Co.

PISTONS

Aluminum Castings Co.
Levett, Walker M., Co.

PISTON RINGS

American Piston Ring Co.

PONTOONS

Niagara Boat Co.
PALMER-SIMPSON CO.
Welin Marine Equipment Co.

PROPELLERS

AMERICAN PROPELLER & MFG. CO.
American Sash & Door Co.
Aviauto Mfg. Co.
Breitung & Co., Ltd.
C. M. O. Physical Laboratory
DOYLE, W. A.
HARTZELL WALNUT PROPELLER CO.
JACUZZI BROS.
JAMESTOWN PROPELLER CO.
Lang Propeller Co. of America
Steves Sash & Door Co.
Reinforced Propeller & Insulating Co., The
United States Aero Propeller Co.
Washington Aeroplane Co.
WEST WOODWORKING CO.

(Continued on page 897)

MARVELITE
Alight at Night

A new book on

Self-Luminous Radium Compounds

Sent free on request

Valuable scientific information for Watch, Clock, Compass and Instrument Manufacturers, who use luminous dials. Tells you how to select material that will meet your particular needs economically, and points out mistakes to be avoided. Contents, in brief:

Phosphorescent Materials. Radium Luminous Compounds. Inspection of Self-Luminous Radium Compounds. Life of Such Compounds. Comparative Luminosity of Fine and Coarse Crystals. High and Low Grade Marvelite.

Send for the book today, and be fully informed on a subject which is going to be a vital one in your business. Keep it for reference.

COLD LIGHT MFG. CO.
558 West 158th Street : : New York

Cold Light Mfg. Co., 558 West 158th St., New York
Please send us, without charge, your book on Self-Luminous Radium Compounds.

Name .....

Address .....

R L M on Battle Planes

AVIATORS in the fighting forces do much of their flying at night. It is of paramount importance that instrument dials be clearly visible at all times. That explains why Radium Luminous Material (RLM) is on aviation instruments in use at the "front."

R L M is reliable as gravity and almost as permanent. No wires, no switches, no upkeep.

Instrument manufacturers will receive further information by addressing Dept. H.

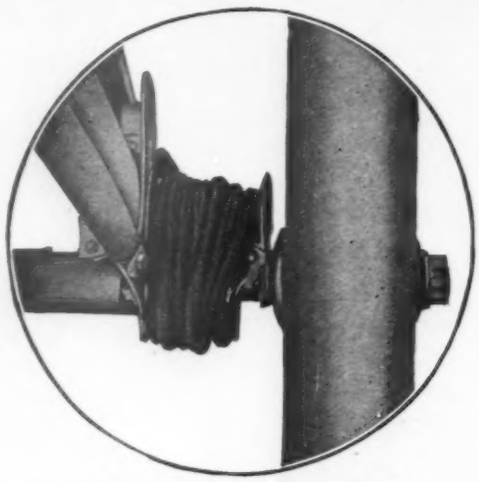
Radium Luminous Material Corporation

55 Liberty St.
New York City

Plants: Orange, N. J.
Boonton, N. J.
Mines: Colorado, Utah

Elastic Aviation Cord

For Shock Absorbers on Airplanes



We originated and have developed this special heavy elastic cord for airplane shock absorbers.

We are the largest manufacturers in the world of Heavy Elastic Cord and owing to our factory capacity we can make prompt deliveries.

Samples on request

J. W. WOOD ELASTIC WEB CO.
FACTORY: STOUGHTON, MASS.

OFFICES

45 East 17th Street . . . . . New York
181 W. Lake Street . . . . . Chicago
82 St. Peter Street . . . . . Montreal, Canada

Fahrig Anti-Friction Metal

The Best Bearing Metal on the Market
A Necessity for Aeroplane Service

Fahrig Metal Quality has become a standard for reliability. We specialize in this one tin-copper alloy which has superior anti-friction qualities and great durability and is always uniform.

When you see a speed or distance record broken by Aeroplane, Racing Automobile, Truck or Tractor Motor, you will find that Fahrig Metal Bearings were in that motor.

FAHRIG METAL CO., 34 Commerce St., N. Y.

TURNBUCKLES

of the

Highest Quality

to Meet the Most
Exact Requirements

Standard Turnbuckle Company

CORRY, PA.

New York Office: Woolworth Building

Aeronautical Trade Directory—*Continued*

PYROMETERS
FOXBORO CO., INC., THE
Moto-Meter Co.
Shore Instrument & Mfg. Co.
TAYLOR INSTRUMENT COMPANIES

RADIATORS
AJAX AUTO & AERO SHEET METAL CO.
A-Z Co.
Bush Mfg. Co.
El Arco Radiators Co.
English & Merrick Co.
FLEXO MFG. CO.
Harrison Radiator Co.
Livingston Radiator Co.
McCord Mfg. Co.
STANDARD ROLLER BEARING CO.

RIVETS
STIMPSON, EDWIN B., CO.

SCELEROSCOPE
Shore Instrument & Mfg. Co.

SHEET METAL FITTINGS
BLUM, JULIUS & CO.
Rogers Construction Co.

SHOCK ABSORBERS
Dural Rubber Corp.
General Rubber Goods Co.
RUSSELL MFG. CO.
WOOD, J. W., ELASTIC WEB CO.

SPARK PLUGS
Bosch Magneto Co.
Champion Ignition Co.
Johns-Manville, H. W., Co.
Rajah Auto Supply Co.
Silvex Co., The
Splitdorf Electrical Co.

SPEED INDICATORS
FOXBORO CO., INC.
Johns-Manville, H. W., Co.
Stewart-Warner Speedometer Corp.

STABILIZERS
Greene Aeronautical Co.
Martin Aerodynamic Stabilizer.
SPERRY GYROSCOPE CO.

STAMPINGS
BLUM, JULIUS & CO.
Enameling & Stamping Corp. of New York
LANSING STAMPING & TOOL CO.
Dewes Co., The A.
STIMPSON, EDWIN B., CO.

STARTERS
Bijur Motor Lighting Co.
Bosch Magneto Co.
Christensen Engineering Co., The
Dayton Engineering Laboratories Co.
MOTOR-COMPRESSOR CO.
Northeast Electric Co.
Remy Electric Co.
Wagner-Hoyt Electric Co.
Johns-Manville, H. W., Co.
Nelson Blower & Furnace Co.
Queen-Gray Co.
Stewart-Warner Speedometer Corp.
Veeder Mfg. Co.

TANKS
Janney, Steinmetz & Co.

THERMOMETERS
FOXBORO CO., INC., THE
Moto-Meter Co.
TAYLOR INSTRUMENT COMPANIES.

TIRES AND RUBBER
Dural Rubber Corp.
GOODYEAR TIRE & RUBBER CO.
Hodgman Rubber Co.
United States Rubber Co.
WOOD, J. W., ELASTIC WEB CO.
Whitley Exerciser Co.

TOOLS
American Tool Works Co.
Bass Brothers
BLUM, JULIUS & CO.
BROOKS MACHINE CO.
Browne & Sharpe
Buffum Tool Co.
Cooper Aeroplane Co., The John D.
HALL-SCOTT MOTOR CAR CO.
HAMMACHER, SCHLEMMER & CO.
LANSING STAMPING & TOOL CO.
Peck, Stowe & Wilcox Co.
Rich Tool Co.
Rogers Works, John M.
Smith & Hemenway
WHITMAN & BARNES MFG. CO.

TRUCKS AND TRAILERS
Federal Motor Truck Co.
Four Wheel Drive Auto Co.
Frenhauf Trailer Co.
Nash Motors Co.
Packard Motor Car Co.
Sechler Company, The
Service Motor Truck Co.
White Company, The

TUBING
American Tube Co.
BLUM, JULIUS & CO.
Dewes Co., The A.
Empire Art Metal Co.
Frasse & Co., Peter A.
National Tube Co.
PENNSYLVANIA FLEXIBLE METALLIC TUBING CO.
STIMPSON, EDWIN B., CO.

TURNBUCKLES
Aero Mfg. & Accessories Co.
DAYTON METAL PRODUCTS CO.
Dillner-Meyer Mfg. Co.
ERIE SPECIALTY CO.
National Aeroplane Co.
New York & Hagerstown Metal Stamping Co.
STANDARD TURNBUCKLE CO.
Steel Products Co.

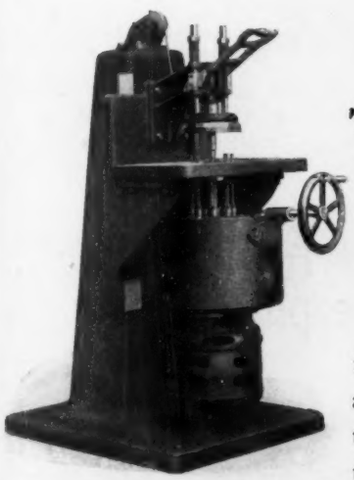
WHEELS
ACKERMAN WHEEL CO.
Dayton Wire Wheel Co.
Hayes Wheel Co.
Mott Wheel Works
NATIONAL WIRE WHEEL WORKS
SPRANGER WIRE WHEEL CORP.
Watson Wheel & Rim Corp.
Wire Wheel Corporation of America

WIRE
American Steel & Wire Co.
Century Telephone Construction Co.
Electric Cable Co.
Rathbone, A. B. & J.
ROEBLING'S SONS, JOHN A.
Simplex Wire & Cable Co.
Upson-Walton Co.

WIRELESS
American Radio & Research Corp.
American Wireless Telegraph Co.
Cutting & Washington, Inc.
Crocker-Wheeler Co.

WIRE WHEELS
FOR
AIRPLANES

WIRE WHEEL REPAIR CO.
INCORPORATED
146 WEST 55th ST., NEW YORK CITY



Yates

Type C-20 Propeller Boring Machine

A recently perfected machine for automatically boring the necessary holes in the modern aeroplane propeller hub in one operation. Extremely durable, compact, and efficient. Does absolutely accurate and uniform work. Specially designed so that no oil can get on and injure the stock. Either belt or direct motor drive.

Send today for complete details

P. B. Yates Machine Co.
BELOIT, WISCONSIN, U. S. A.

WIRE WHEELS

FOR COMBAT AND ALL OTHER TYPES OF

AIRPLANES

CONTRACTORS TO
LEADING AIRPLANE COMPANIES

Our Engineering Department will gladly cooperate with you in your experimental work

SPRANGER WIRE WHEEL CORPORATION

DETROIT, U. S. A.

NEW YORK REPRESENTATIVE
THOS. C. CHEASLEY
137 West 47th Street Phone Bryant 8570

Multiple Storage Batteries

deliver

20 Watt Hrs. per lb. of Elements. Multiple Storage Batteries are the LIGHTEST and most POWERFUL manufactured for aeronautical motor ignition and starting systems.

Correspondence invited

MULTIPLE STORAGE BATTERY CO.,
427 West 50th Street, New York City

IN ACTUAL DAILY PERFORMANCE

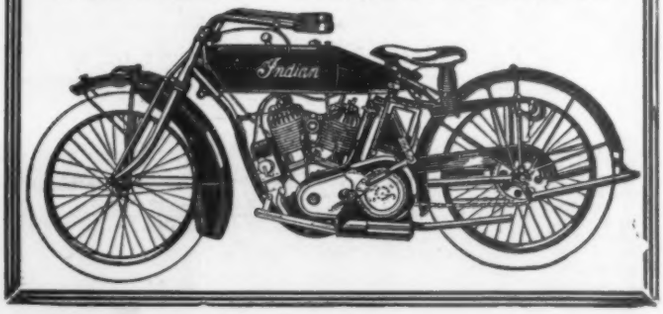
In every branch of military service—Engineering Corps, Aviation Section, Quartermaster Corps, and general Patrol, Scout, and Dispatch duty—you will find the

Indian Motocycle
With Powerplus Motor

Greatest strength, endurance, speed, power, accessibility, and all-round dependability.
We will be pleased to arrange demonstrations of all Indian models for interested military officials

Illustrated Indian Catalog and other descriptive literature sent anywhere on request

HENDEE MANUFACTURING COMPANY
(Largest Motorcycle Manufacturers in the World)
767 STATE STREET SPRINGFIELD, MASSACHUSETTS



WEST WOODWORKING COMPANY

(Patent Pending)

Manufacturers of

Westmoore Propellers
Swesco Wing Beams
Waterproof Plywood Panels
Laminated Construction for All Parts

Highest Quality
Quantity Production
Prompt Shipments

Address:

WEST WOODWORKING COMPANY
308-324 N. Ada Street Chicago
Cable address "SWESCO"

Cabinet makers with over thirty years' successful business behind them

STIMPSON-RIVETS

LARGE STOCK REGULAR SIZES — SPECIAL TO ORDER

WE MAKE SCREW HEAD NAILS AND RIVETS FOR EVERY PURPOSE.
EYELETS, HOOKS, GROMMETS AND WASHERS FOR SHOES, SHELTER TENTS, CORSETS, LEGGINS, MAIL BAGS.

70 FRANKLIN AVENUE 70 BROOKLYN, NEW-YORK

FOXBORO
TRADE MARK

QUALITY INSTRUMENTS FOR AIRPLANES

Airspeed Indicator or Buoyancy Meter
Gasoline Level Indicator
OIL PRESSURE GAUGE

Indicating Dial Type Thermometer
for circulating oil and water
AIR PRESSURE GAUGE

The Foxboro line also includes many different types of indicating and recording gauges and thermometers designed for all sorts of conditions and purposes.

THE FOXBORO CO., Inc., FOXBORO, MASS., U.S.A.

NEW YORK CHICAGO PITTSBURGH PHILADELPHIA ST. LOUIS
SAN FRANCISCO BIRMINGHAM, ALABAMA PEACOCK BROS., MONTREAL

DROP FORGINGS

THE WHITMAN & BARNES MANUFACTURING CO.
ESTABLISHED 64 YEARS
1000 WEST 120th STREET, CHICAGO, ILL.

Automotive Engineers

interested in the superior performance of their

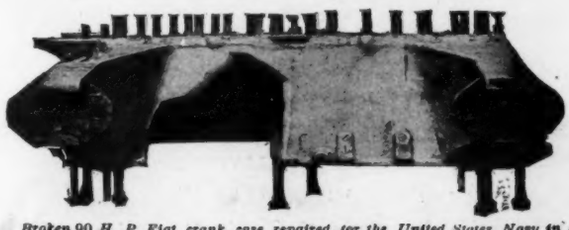
Aeronautical Motors

should communicate with us without delay

METAL PRODUCTS CO.
3205 South Broadway
St. Louis, Mo.

DON'T SCRAP ALUMINUM PARTS

USE SO-LUMINUM—NEW WELDING SOLDER



Broken 90 H. P. Fiat crank case repaired for the United States Navy in six hours' time and at $15.00 expense by use of So-Luminum, as against $400.00 and five months' time to get a new one—is in perfect condition after two years' use Use gasoline or blow torch—no flux or special tools required.

Booklet and directions on request. Sample bar, $1.00. Used and indorsed by the United States Army and Navy, auto and aero. companies, and indorsed by the British Munitions Board.

SO-LUMINUM MFG. & ENG. CO., Inc
Room 25, 1790 Broadway New York City

SEAMLESS STEEL TUBING

Large Stock on Hand

Prompt Mill Deliveries

COLD DRAWN SHAFTING AND SCREW STEEL

Eastern Distributor: BORDENTOWN STEEL & TUBE CORP.

JULIUS BLUM & COMPANY **510-512 West 24th Street, New York, N. Y.**

Branches: Boston, Chicago, Philadelphia

ORDNANCE ENGINEERING CORPORATION

NEW YORK OFFICE
120 Broadway, Equitable Building

LONDON OFFICE
19 Queen Anne Chambers, Westminster, S. W.

Government Contractors : : Consulting Engineers

Manufacturers of Illuminating Shells, Trench Howitzers, Hand Grenades, etc., etc.

Naval and Military Appliances and Parts designed, developed and perfected

Designers and Builders of Military and Naval
AIRCRAFT

Aviation Photographic Equipment

The Brock Automatic Camera, Type IV
The Brock Automatic Camera, Type V
Enlarging Machines, Scale Map Printing Machines, Special Map Drawing Instruments
Field Dark-Room (Collapsible)

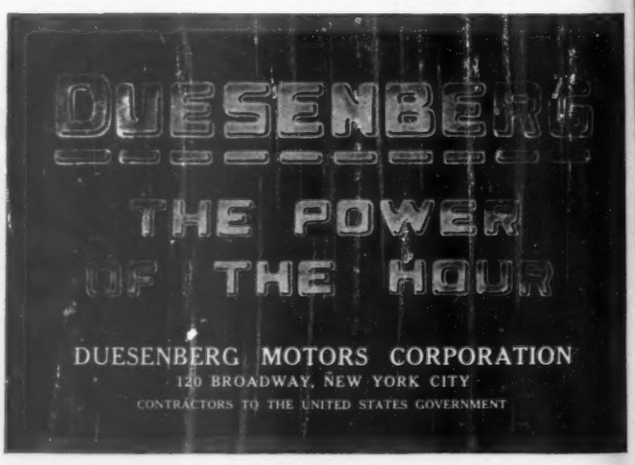
The only Cameras that permit good enlargements from negatives made at speeds of over 100 miles per hour.

ARTHUR BROCK, JR.

OFFICE—511 BULLITT BUILDING, 131 SO. FOURTH STREET
FACTORY—533 NO. ELEVENTH STREET
PHILADELPHIA, PA.

Scientific Instruments, Tools, Dies, Jigs and Fixtures

Factory occupies 23,000 square feet of floor space Screw Machine Capacity up to 2¼ inches.



D'Orcy's Airship Manual

"A singularly timely and useful work, which does for the aerial navies of the world something like what Brassey's Annual does for the marine fleets."—*New York Tribune, June* 8, 1918.

$4.00

THE GARDNER-MOFFAT CO., INC.
120 West 32d Street New York

For Your Flying ← Boats Use

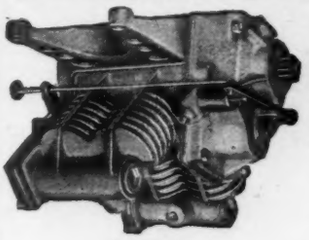
Send for Booklets—

"Marine Glue, What to Use and How to Use It" and "How to Make Your Boat Leakproof."

L. W. Ferdinand & Co.
152 Kneeland Street
Boston, Mass., U. S. A.

U. S. and Foreign Governments Approve The "Perfect Starter"

This is a compressed air starter convertible to an air compressor for storing the air for its own energy. It has ample power and speed for magneto starting.



Model C

Model C—For starting engines up to 250 H.P.; weighs 39 lbs. and complete for single engine installation 70 lbs., for twin engines 110 lbs.

Model D—For starting engines up to 150 H.P.; weighs 34 lbs. and complete for single engine installation 58 lbs., for twin engines 96 lbs.

Write for Booklet

THE MOTOR-COMPRESSOR CO.
Newark, New Jersey, U. S. A.

AIRPLANE MANUFACTURERS

The United States Government uses and endorses

THE WARNER AIRPLANE CONTROL

"There's a Reason"

particulars furnished upon request

Wm. Deshler Warner—*Sole Mfgr.*
Eight · East · Broad · Street
COLUMBUS····OHIO

Rubber Aero Cord

FOR SHOCK ABSORBERS

Prompt Delivery

THE RUSSELL MANUFACTURING CO.
349 Broadway, New York City
Factories: MIDDLETOWN CONNECTICUT

HULLS FOR FLYING BOATS

PONTOONS FOR SEAPLANES

Palmer-Simpson Corporation
Saranac Lake, N.Y.

AMERICAN PROPELLER & MFG. CO.
PARAGON
BALTIMORE MARYLAND U.S.A.

ENGINEERING PRESENTATION OF

INVENTIONS

AERONAUTIC, MUNITION, MOTOR, GAS AND FLAME, SUBMARINE, POWER, TANKS, WEAPONS, INSTRUMENTS AND ACCESSORIES.

IDEAS INVESTIGATED, CALCULATED AND DEVELOPED

PREDICTED VALUES *and* STRESS DIAGRAMS

PLANS, GENERAL DESIGN AND DETAILED MANUFACTURING DRAWINGS

AUTOMOTIVE ENGINEERING COMPANY
7TH FLOOR, 120 SOUTH STATE STREET, CHICAGO, ILL.

ROEBLING AIRCRAFT WIRE

STRAND AND CORD

Thimbles and Ferrules

John A. Roebling's Sons Co.
TRENTON, NEW JERSEY

Agencies and Branches
New York Boston Chicago Philadelphia Pittsburgh Cleveland
Atlanta San Francisco Los Angeles Seattle Portland, Ore.

All recognized builders of airplane motors in America use *Zenith* on their product.

Zenith Carburetor Company

New York DETROIT Chicago

PROPELLERS

WA DOYLE
TRENTON NJ

CAPITAL INTERNAL GRINDER **STAMPINGS** JIGS TOOLS DIES

WE realize *in air* or *at sea* there should be *no faulty* material. All machine parts must be made *right* and perform their functions *properly*, hence we have equipped our new plant to turn out work of the highest quality. We offer our facilities to you and trust we may be of service.

Will you give us a trial?

LANSING STAMPING & TOOL CO.

LANSING, MICHIGAN

PENNSYLVANIA INTERLOCKING METAL HOSE

METAL HOSE

For every Airplane Requirement

Write for specifications and prices

PENNSYLVANIA FLEXIBLE METALLIC TUBING COMPANY

Broad and Race Streets, Philadelphia

New York, Boston, Chicago, Detroit, Cleveland

LEYGRAND & CO.

120 Broadway, New York

MILL AGENTS

ALUMINUM SHEETS

Screw Stock, Rod and Wire

Tycos

Aviation Barometer

Made in U. S. A.

Write for Information

Taylor Instrument Companies

Rochester, N. Y. U. S. A.

For over sixty years makers of scientific instruments of superiority

THE BROOKS MACHINE CO.

Designers and Manufacturers of

SPECIAL TOOLS,
GAUGES OF ALL KINDS,
JIGS, FIXTURES *and* PARTS *for*
AIRPLANE ENGINES

YORK, PENNA.

Wisconsin

CONSISTENT

AEROPLANE MOTORS

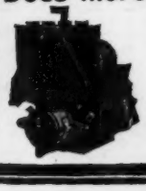
are correctly designed with the highest quality materials and workmanship.

Write for catalog of 6 and 12 cylinder models.

WISCONSIN MOTOR MFG. CO.

Station A. Dept. 338. Milwaukee, Wis., U. S. A.

PASCO
Wire Wheels For AIRPLANES
USED ON THE BEST
ORDERS NOW BEING TAKEN FOR PROMPT DELIVERIES
WRITE FOR PRICES
National Wire Wheel Works, Inc.
GENEVA, NEW YORK

Berling Magneto
insures a hot, fat spark at any altitude
Worth more
Does more

Manufactured by the Ericsson Mfg. Co. Buffalo N.Y. U.S.A.

DOEHLER
BABBITT-LINED BRONZE
BEARINGS
have been used for years with the utmost success by the leading motor manufacturers in the automobile and airplane industries.
DOEHLER DIE-CASTING CO.
MAIN OFFICE AND EASTERN PLANT
WESTERN PLANT TOLEDO, OHIO. BROOKLYN, N.Y. NEW JERSEY PLANT NEWARK, N.J.
Also Die-Cast Babbitt Bearings, Die-Castings in Brass & Bronze Aluminum and White Metal Alloys

Aeroplane Cylinder Forgings
We make a specialty of hollow forging in dies under our hydraulic presses, aeroplane cylinder forgings of high and low carbon O.H. or alloy steels.
We have furnished cylinder forgings to practically all the engine builders in the United States.
Also Propeller Hubs, Flanges and Shafts, etc
Miscellaneous steam hammer and hydraulic press die forgings of all types.
Quick service our specialty
TIOGA STEEL & IRON COMPANY
52nd & Grays Avenue Philadelphia, Pa., U. S. A.

"Supremacy in the Air the Key to Victory!"
Learn Aviation Mechanics
Train Yourself for the Aviation Service and the Aircraft Industry by taking advantage of
Our Ground Course in Aviation Mechanics
Affording preparation prior to entering Government Ground School, covering aero-dynamics, aero-engines, rigging and Lewis gunnery. Previous experience unnecessary.
WE ARE THE PIONEER AVIATION SCHOOL
Aviation Mechanics Course $60 (6 weeks)..... Aero-Engine Course $35 (4 weeks).....
Wireless Course (4 weeks)... $25
Write for our Illustrated Booklet "F"—"A Message to You on Aviation"
EAGLE AVIATION SCHOOL
110-114 West 42d Street
Telephone Bryant 9078
New York

Quality Springs
Specialists in Heat-Treating Vanadiums
New York Wire & Spring Company
586 Washington Street, New York

Classified Advertising

10 cents a word, minimum charge $2.00, payable in advance. Address replies to advertisements with box numbers, care of AVIATION AND AERONAUTICAL ENGINEERING, 120 West 32d Street, New York.

FOR SALE—Two Model "O" Curtiss and "80" eight-cylinder aviation motors complete with blades, tanks and radiators. These motors practcally new. Priced right for cash. Address C. C. Sidnam, P. O. Box 275 Anaheim, Cal.

WANTED—Experienced draftsmen or draftswomen immediately. State experience, age, salary expected and reference. Gallaudet Aircraft Corp., East Greenwich, R. I.

FOR SALE—Biplane, passenger, 50 H.P. 4 cylinder motor; Nieuport monoplane, 7 cylinder rotary 65 H.P. motor, guaranteed, terms, sell separately very cheap. Michael Dettmar, 3336 South Broadway, St. Louis, Mo.

FOR SALE—Tractor seaplane, new, nearly completed. Farman-Curtiss pusher. Exhibition pusher two-thirds completed. Monoplane parts. Pontoons. Propellers. At small fraction of cost. 986 Trumbull Ave., Detroit, Mich.

WANTED—Six-cylinder Anzani motor in good condition. Box 85.

INDEX TO ADVERTISERS

A

Ackerman Wheel Co. 884
Ajax Auto & Aero Sheet Metal Co. 892
Aluminum Co. of America. 890
American Propeller & Manufacturing Co. 901
Automotive Engineering Co. 901

B

Baker Castor Oil Co. 889
Barcalo Mfg. Co. 891
Beech Flight System Corp. 890
Betz-Pierce Co., The. 848
Blum, Julius, & Co. 900
Boston Auto Gage Co. 892
Brock, Arthur, Jr. 900
Brooks Machine Co. 902
Burgess Co., The. 844

C

Chemical Products Co. 889
Cold Light Manufacturing Co. 895
Continental Aircraft Corp. 882
Curtiss Aeroplane & Motor Corp. 908

D

Dalton Manufacturing Corp. 894
Dayton Metal Products Co. 907
Defiance Machine Works. 894
Doehler Die Casting Co. 903
Doyle, W. A. 902
Duesenberg Motors Corp. 649
Dural Rubber Corp. 703

E

Eagle Aviation School. 903
Ericsson Manufacturing Co. 903
Erie Specialty Co. 853

F

Fahrig Metal Co. 896
Ferdinand, L. W. & Co. 901
Flexo Manufacturing Co. 892
Foxboro, The, Co. 899
Fox Machine Co. 894

G

General Bakelite Co. 893
Gillette Safety Razor Co. 905
Goodyear Tire & Rubber Co. 879
Grand Rapids Veneer Works. 887
G. and O. Mfg. Co. 888

H

Hall-Scott Motor Car Co. 843
Hammacher, Schlemmer & Co. 884
Hendee Manufacturing Co. 898
Holbrook Co., The. 883

I

International Aeronautical Instrument Corp. 889

J

Jamestown Propeller Co. 887
Jacuzzi Bros. 888

L

L. W. F. Engineering Co. 845
Lansing Stamping & Tool Co. 902
Lawson Aircraft Corp. 874-875
Leygrand & Co. 902
Loening, Grover C. 889

M

Martin, Glenn L., Co. 842
Mattison, C., Machine Works. 894
Mayo Radiator Division. 849
Metal Products Co. 899
Motor-Compressor Co. 901
Multiple Storage Battery Co. 898

N

National Wire Wheel Works. 903
New Departure Mfg. Co. 856
New York Wire & Spring Co. 903
Norma Co. of America. 854

O

Ordnance Engineering Co. 900

P

Palmer-Simpson Co. 901
Park Drop Forge Co. 885
Penn. Flexible Metallic Tubing Co. 902
Pryibil, P., Machine Co. 886

R

Radium Dial Co. 885
Radium Luminous Material Corp. 896
Roebling's, John A., Sons Co. 901
Rome-Turney Radiator Co. 892
Russell Manufacturing Co. 901

S

So-Luminum Mfg. & Eng. Co. 899
Sperry Gyroscope Co. 855
Spranger Wire Wheel Corp. 898
Standard Aircraft Corp. 847
Standard Turnbuckle Co. 896
Stimpson, Edward B., Co. 899
Strauss & Buegeleisen. 883

T

Taylor Instrument Companies. 902
Thomas-Morse Aircraft Corp. 881
Tioga Steel & Iron Co. 903

U

Union Gas Engine Co. 846

W

Wakefield, C. C. Co., Ltd. 882
Warner, Wm. Deshler. 901
West Woodworking Co. 898
Whitman & Barnes Manufacturing Co. 899
Widman, J. C., & Co. 886
Wire Wheel Repair Co. 897
Wisconsin Motor Manufacturing Co. 902
Witteman-Lewis Aircraft Co. 882
Wood, J. W., Elastic Web Co. 896
Wyman-Gordon Co. 854

Y

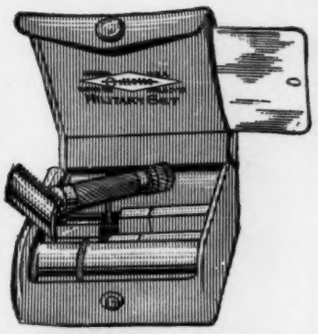
Yates, P. B., Machine Co. 897

Z

Zenith Carburetor Co. 902

Gillette SAFETY RAZOR

The New U. S. Service Set—A solid metal case, heavy nickel-plated and embossed with the Insignia of the U. S. Army and Navy Strong, thin, compact; 1¾ inches wide, 4 inches long, ¾ inch thick. 12 double-edged Gillette Blades (24 Shaving Edges). Contains a nickel-plated Gillette Safety Razor and Blade Box. Indestructible Trench Mirror inside the lid. **$5**



Military Set No. 18—For Uncle Sam's Officers, a Gillette Combination Set, in case of U. S. Regulation Khaki twill — nickel-plated "Bulldog" Razor; indestructible Trench Mirror fitted in pocket in lid; Shaving Brush and Stick Gillette Shaving Soap in nickel-plated Holders; two Blade Boxes; 12 double-edged Gillette Blades (24 Shaving Edges). **$7**

In the Service a Man is Handicapped without a Gillette

A few days of camp life puts it all off with the old razor and on with the Gillette for keeps! Time is crowded. A man's day is full of things to be done just so—on the jump—to the minute.

That means the Gillette! Shaving done and out of the way in three to five minutes. A cleaner, smoother shave than is possible with an old-fashioned razor. *Shaving Quality* that every man can depend upon, whether in barracks, between decks, or in a billet within sound of the big guns.

Have you seen the new Gillette Sets specially made for the fighting man? Two of them are illustrated on this page. They were designed by members of the Gillette Organization in the Service—men who know what the fighting man is up against.

Simple and compact, fit the pack, the pocket or the ditty box. No strops or hones to clutter up the kit. Blades always sharp, always ready. No Stropping—No Honing. When a man wants new Blades he can get them in any Post Exchange, Ship's Canteen, or Y. M. C. A. Hut, here in America or overseas.

Our Paris office carries stocks—is constantly supplying the American Expeditionary Forces. Gillette Safety Razors and Blades on sale everywhere in France, England, Italy, and the Eastern battle fronts.

Here's the Way to Get 100% Efficiency Out of Your Gillette

Try this when you shave tomorrow morning. Lather the beard thoroughly, and rub well in—that's essential with any shave.

Put in a new blade and screw the handle down *tight*. If you want a specially close shave, *unscrew* the handle a *part turn*.

Hold the razor *naturally* and *easily*, and tilt the handle so you can just feel the blade engage the beard.

Then shave with short slanting strokes. It doesn't require any brute force to shave with a Gillette—the razor does the work.

Gillette Safety Razor Co.
of Canada, Ltd.
73 St. Alexander St.
Montreal, P. Q. Canada

Gillette Safety Razor Societe
Anonyme
17 Bis, Rue La Boetie
Paris, France

Gillette Safety Razor, Ltd.
200 Great Portland St.
London, W., England

A. G. Micheles
53 Liteiny, Petrograd, Russia

Vedova Tosi Quirino & Figli
Via Senato, 18
Milan, Italy

Gillette Safety Razor Company
Boston Mass·U·S·A·

TRADE FOX MARK

MILLING MACHINES

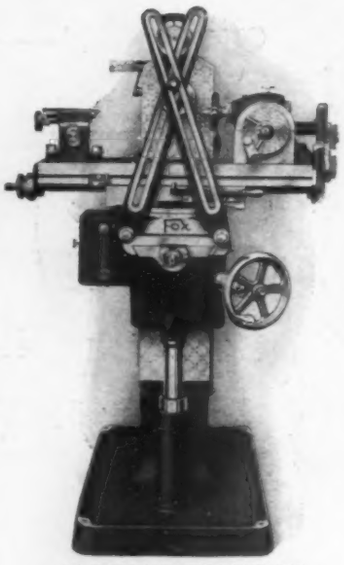
For Rapid Production of Motor Parts

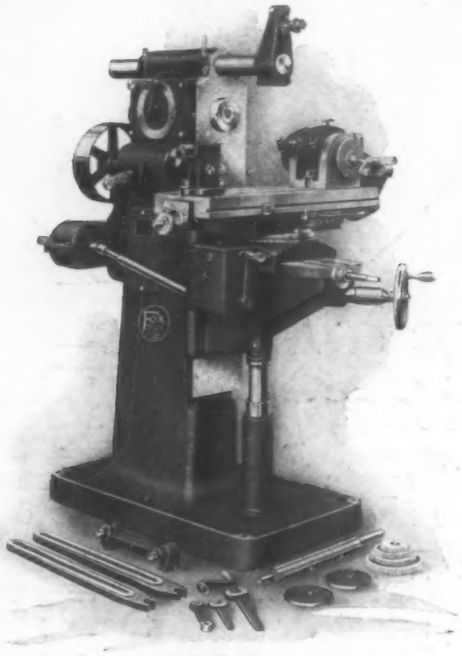
The *demand* for increased production *requires tools* of *great strength* and *durability;* the Fox 2-A Universal Milling Machine illustrated has met this demand, and is being used wherever extreme accuracy and quantity production are required.

The machine has a universal table, spiral cutting attachment, 10″ Dividing Head with 6″ Universal Chuck, making it a machine *especially adapted for Tool Room Work.*

The *United States Government* is using this machine in its various *repair shops* for *Aeroplane Motors.*

You should be using this tool to help the production of parts necessary for the prosecution of the war.





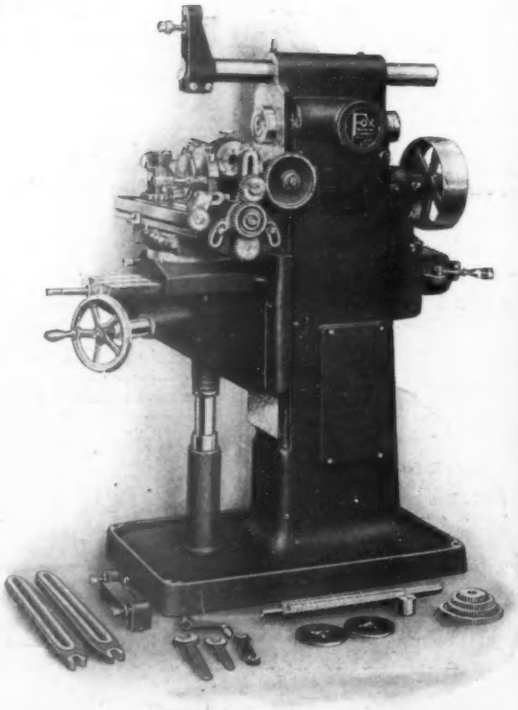
SPECIFICATIONS
No. 2-A Miller

Spindle Speeds—12 from 21 to 423 RPM.
Table Feeds—6 from .317″ to 2.79″ per min.
Table—8½ x 27″
Long. feed (power) 26″
Vertical feed (hand) 13″
Trans. feed (hand) 8½″
Drive—Single Pulley 10 x 3″ running 250 RPM.
Gears—Hardened Steel
Weight—1500 lbs.

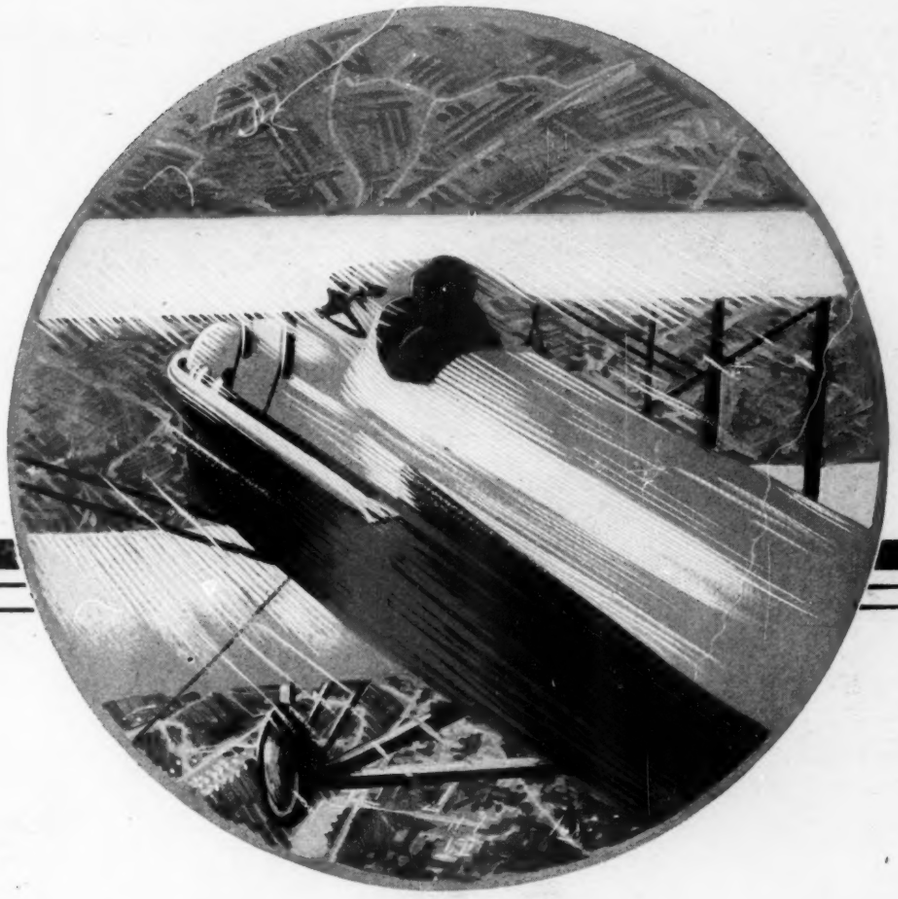
We build this same machine with a plain table, omitting the spiral cutting attachment and Dividing Head.

Our No. 1 type machine has a four step cone drive, and while being a lighter machine, is a "bear" for work, this is *proven by* the *hundreds* of *them in* the *largest munitions plants.*

We also build the Fox Multiple Spindle Drilling Machines.



Fox Machine Company
1811 West Ganson Street
Jackson, Michigan, U. S. A.



We manufacture the following parts for airplanes

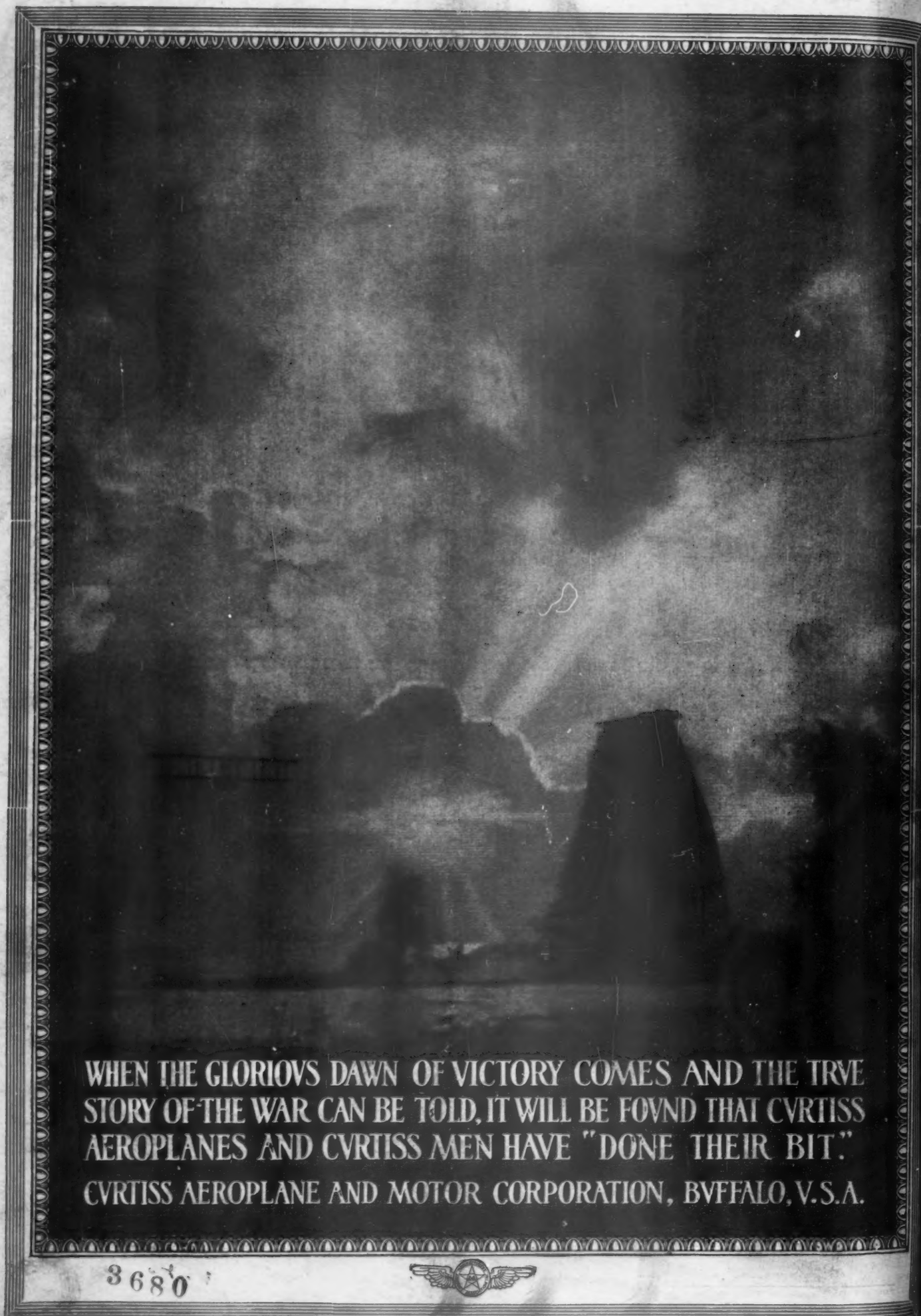
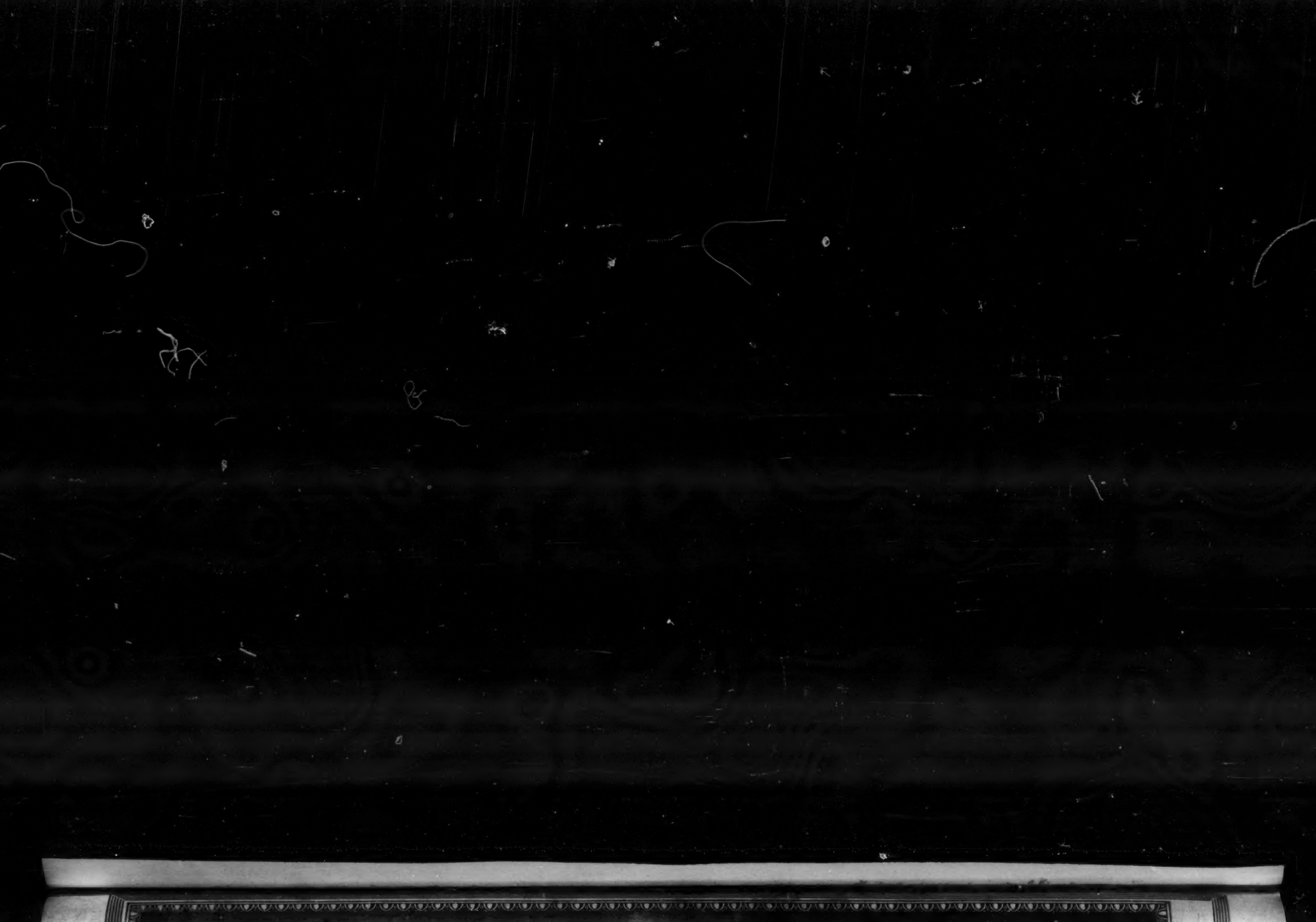
All Standard Types of Turnbuckles Tie Rods and Clevises Thimbles Bolts and Clevis Pins

THE

DAYTON METAL PRODUCTS CO.

DAYTON, OHIO, U. S. A.

THE WILLIAMS PRINTING COMPANY, NEW YORK


WHEN THE GLORIOVS DAWN OF VICTORY COMES AND THE TRVE
STORY OF THE WAR CAN BE TOLD, IT WILL BE FOVND THAT CVRTISS
AEROPLANES AND CVRTISS MEN HAVE "DONE THEIR BIT."
CVRTISS AEROPLANE AND MOTOR CORPORATION, BVFFALO, V.S.A.

3680